SEPTEMBER, 1956

Traffic Engineering

CONVENTION ISSUE

How Modern Transit Can Help Solve City Parking Problems

The parking squeeze is tighter now than at any other time in our history. There just isn't enough space in our business districts to accommodate all of our automobiles. The resulting loss of business and tax revenues and the prohibitive cost of making room for more cars is of real concern to all communities.

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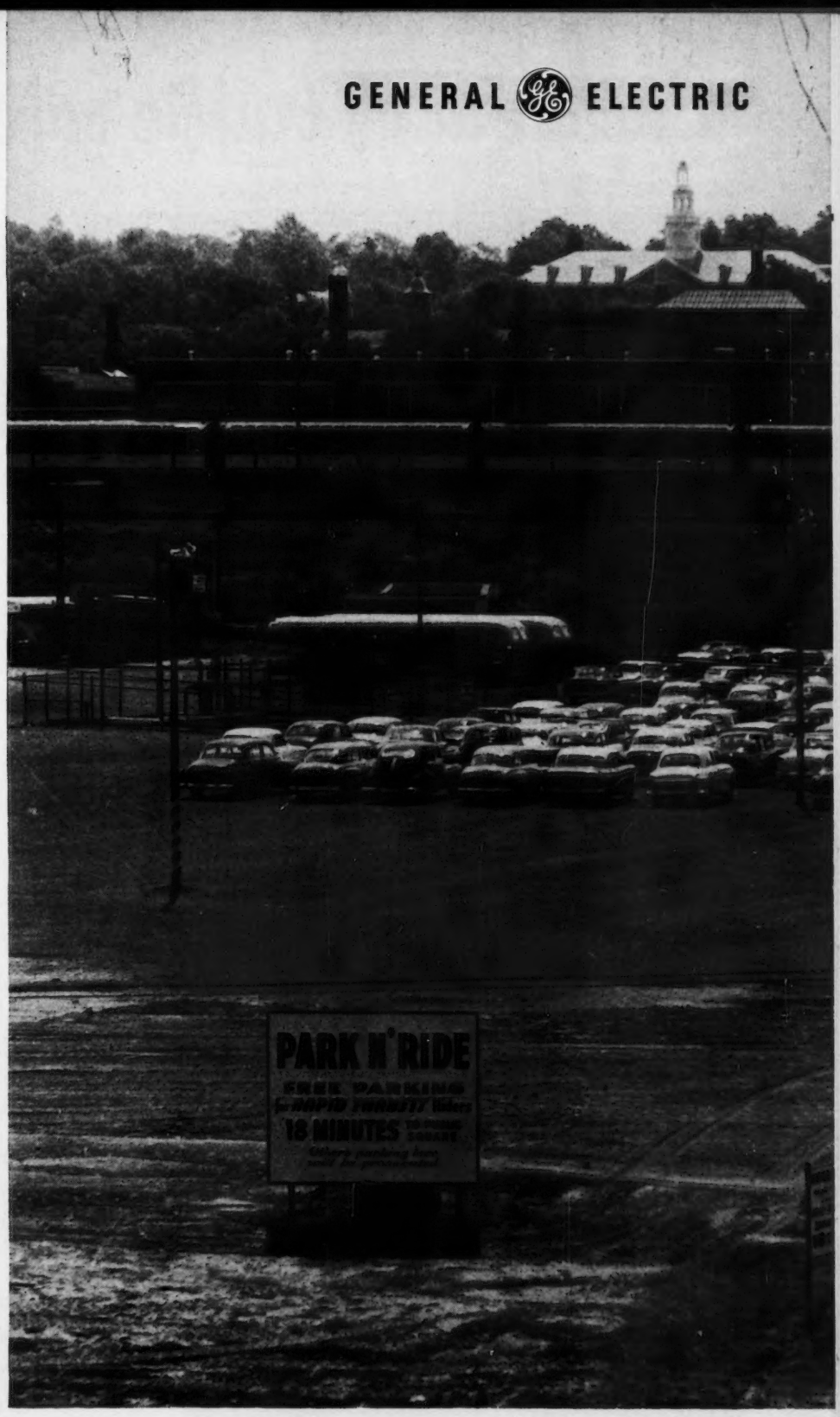

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Dwight T. Myers,
President

Traffic Engineering

OFFICIAL PUBLICATION OF THE INSTITUTE OF TRAFFIC ENGINEERS

Vol. 28 SEPTEMBER, 1956 Number 12

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DEFINITION: Traffic Engineering is that phase of engineering which deals with the planning and geometric design of streets, highways, and abutting lands, and with traffic operation thereon, as their use is related to the safe, convenient, and economic transportation of persons and goods.

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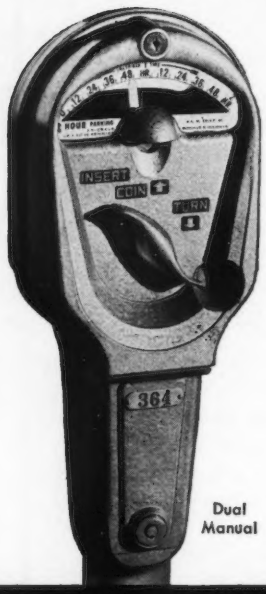

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Frankly Speaking . . .

THE INSTITUTE OF TRAFFIC ENGINEERS is twenty-six years old. It has reached and passed its majority and is entering upon an age which poses for its members a great challenge and offers them limitless opportunities. Certainly, all of us can feel proud in being members of an organization which has done so much in so short a time. And we can look forward with confidence that our efforts will be rewarded by further expansion in the membership of the Institute.

The new Federal Highway bill has been passed by the Congress and signed into law by the President, and as a result our nation's highway construction program will more than double. Traffic engineering techniques will be called into service as never before in this the largest highway building program ever undertaken by man. Particularly in the urban areas is this true, for here the traffic engineer can do so much to aid in planning highway locations and designing interchanges to assure safe and orderly flow of traffic. Here too, traffic engineers, by their training, can do so much to improve traffic services on existing facilities.

The very nature of the traffic engineers' work involves making decisions which to varying degrees affect the public interest. The acceptance by the public of the traffic engineers' role in improving highway transportation services is an indication of the scientific exactitude with which they have developed their techniques and with which they have performed their duty to the public.

The annual meeting in San Francisco from September 25 through the 27th will provide every member delegate with an opportunity to review the past and to peer into the future. It will provide him, too, with new ideas and with new tools to solve old problems.

Representatives from colleges and universities, from business groups and from highway research bodies will be on the program to discuss those things which are of current interest. Certainly each one of us will leave San Francisco wiser in the various traffic engineering techniques.

H. C. HIGGINS
Director, District 6

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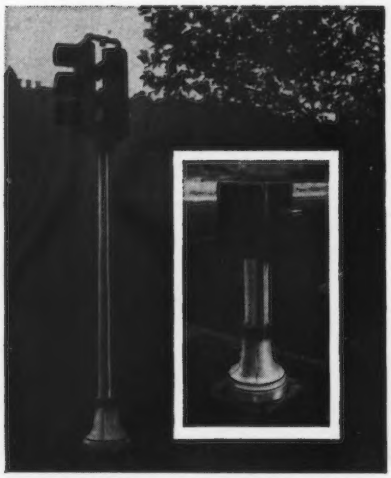

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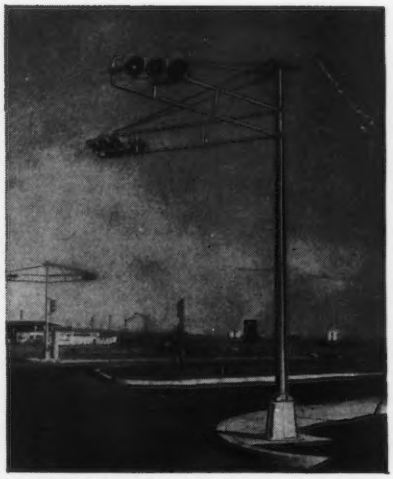

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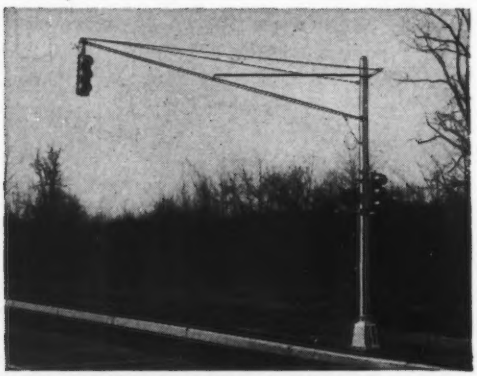

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26th ANNUAL MEETING
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Tuesday, Sept. 25th

OPENING CEREMONIES — President Prisk, presiding

SESSION No. 1 — A LOOK TO THE FUTURE

H. C. Higgins, presiding

10:15-10:45—"The Urban Area of the Future"—Robinson Newcomb, Consultant, Washington, D. C.

10:45-11:15—"The Urban Transportation System of the Future"—Charles E. DeLeuw and William R. McConochie, DeLeuw, Cather & Co., Chicago, Ill.

11:15-11:45—"The Challenge to the Traffic Engineer"—J. O. Mattson, President, Automotive Safety Foundation, Washington, D. C.

KICKOFF LUNCHEON — Noon

SESSION No. 2 — URBAN TRANSPORTATION PLANNING

J. Carl McMonagle, presiding

2:00- 2:40—"The Effect of the Expanded Federal Highway Program on Traffic Engineering"— G. Donald Kennedy, President, Portland Cement Association, Chicago, Ill.

2:40- 3:20—"Metropolitan Area Transportation Studies"—Edward M. Hall, Transportation Research Director, San Diego, Calif.

TRAFFIC ENGINEERING RESPONSIBILITY FOR SAFETY

Matthew C. Sielski, presiding

3:30- 4:10—"The Role of the Traffic Engineer in Subdivision and Shopping Center Planning"—George Barton, Engineering Director, Associated Consultants, Evanston, Ill.

4:10- 4:40—"Traffic Safety—An Engineering Responsibility"—Roy E. Jorgensen, Engineering Counsel, National Highway Users Conference, Washington, D.C.

Wednesday, Sept. 26th

BISCUIT BANTER BREAKFAST—Top of the Mark

SESSION No. 3 — CONCURRENT SESSIONS OF THE TECHNICAL DEPARTMENTS

Joseph E. Havenner, coordinator

9:15-11:45—*Department No. 1*—Traffic Engineering Administration—Jerome D. Franklin, head.

9:15-11:45—*Department No. 2*—Professional Standards & Education for Traffic Engineering—Donald S. Berry, head.

9:15-11:45—*Department No. 3*—Traffic Control Operations (Measures)—James E. P. Darrell, head.

9:15-11:45—*Department No. 4*—Traffic Control Operations (Devices)—William R. Marston, head.

9:15-11:45—*Department No. 5*—Planning & Geometric Design of Traffic & Pedestrian Ways—J. Al Head, head.

9:15-11:45—*Department No. 6*—Planning & Geometric Design of Terminal Facilities—Edmund R. Ricker, head.

9:15-11:45—*Department No. 7*—Design of Equipment—Wayne N. Volk, head.

FIELD TRIP — Wednesday afternoon

Thursday, Sept. 27th

ANNUAL BUSINESS MEETING — Thursday morning, 9 a.m. (Members only, all grades)

BOARD LUNCHEON WITH PAST PRESIDENTS (Board Members and Past Presidents only)—12 Noon

SESSION No. 4 — WHAT'S NEW IN TRAFFIC ENGINEERING

Karl A. Bevins, presiding

1:30- 2:10—"Automation in Traffic Control"—Edmund R. Ricker, Traffic Engineer, N. J. Turnpike Authority, New Brunswick, N. J.

2:10- 2:50—"Research on Operating Characteristics of Freeways"—Karl Moscowitz, Ass't. Traffic Engineer, California Division of Highways, Sacramento, Calif.

SOLUTIONS TO SOME SPECIFIC PROBLEMS

Burton W. Marsh, coordinator

3:00- 4:30—A panel of young members of the Institute will discuss some of their work on specific engineering problems.

ANNUAL BANQUET — Thursday evening

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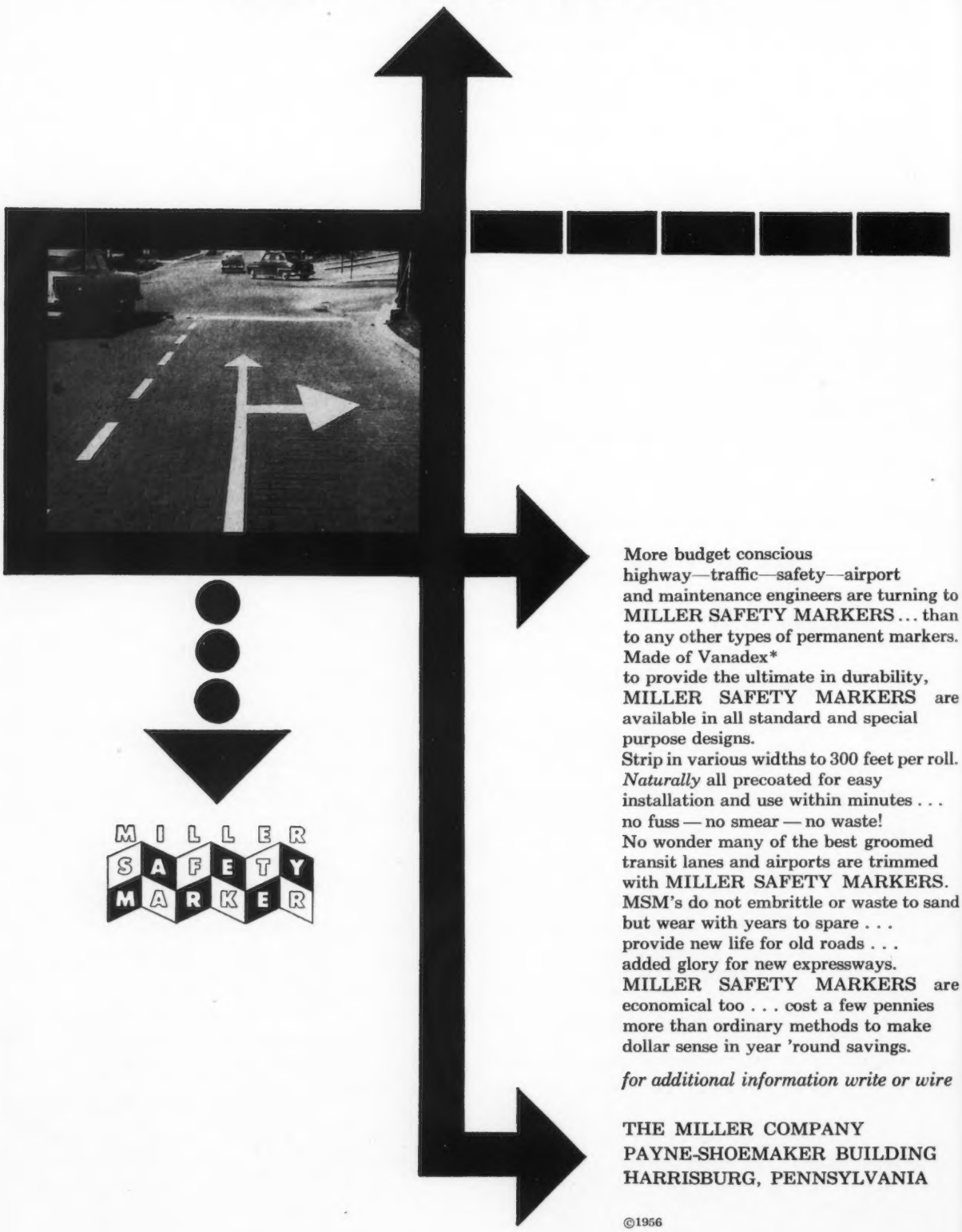

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Traffic Engineering in San Francisco

By Ross T. Shoaf (Mem., ITE)
Traffic Engineer, City of San Francisco

and

William Marconi, (Jun. Mem., ITE)
Assistant Traffic Engineer, City of San Francisco

The San Francisco Convention Committee Tour will not be primarily a technical trip. The authors in the accompanying article list many traffic engineering techniques which can be observed by visitors. They will welcome the opportunity to arrange inspections but request advance indications of desires. Friday morning after the convention is suggested as the best time to program such trips.

SAN FRANCISCO, the 1956 Convention City, is both the financial and cultural center of the western United States. This is sometimes disputed by a village about 400 miles to the south where they make movies. However, a true San Franciscan, along with never saying "Frisco," looks down his nose at this attempted rivalry.

Located in a setting of great natural beauty, rivalled only by a few places such as Rio de Janeiro, the San Francisco Bay Area is truly a wonderful place to visit. Within its confines are found the primitive majesty of the redwood groves, remnants of the historical days of the Gold Rush of '49 and a diverse and sometimes paradoxical cosmopolitan culture that will enchant the visitor.

In the musical plane, there are three fine opera companies; an excellent symphony and numerous bars that feature of all things, operatic singers as entertainment. On the other end of the musical scale, however, it has been the center of a revival of Dixieland jazz which is featured in many of the famous night clubs.

The downtown area is actually one of the newest in American cities, dating almost in its entirety from 1906 onward when it was rebuilt after the great fire and earthquake. Still, within the city limits is one of the oldest buildings on the west coast, located in the famous old Presidio, headquarters of the Sixth Army. This building was constructed in 1776 and now serves as the Officers' Club. Also located in the city are some old mission buildings built by the Franciscan padrés in the late 1700's.

San Francisco has been populated by a diversity of nationalities which has helped give it a cosmopolitan atmosphere and a peculiar charm all of its own. Within the boundaries of Chinatown is the largest Chinese community outside the Orient. The Italian community, the largest in San Francisco, is centered in North Beach and has many of the finest restaurants in the city. Other nationality groups such as Russians, Swedes, Irish, Japanese and French and many others

Fig. 1

Market Street in San Francisco—the Ferry Building is in the background and one of the few remaining "bird cage" signals is in the foreground.

Fig. 2

Offset one way streets. The heavy eastbound movement on Oak Street at the top of the picture turns north on Franklin Street for one block and then resumes its eastward flow on Fell Street at the bottom of the picture. The figures are peak hour volumes.

Fig. 3

Channelization permitting two lanes to make a left turn.

have also left their distinctive mark both in eating places and in cultural atmosphere on the City by the Golden Gate.

Finally, the geography of the area has made its imprint upon San Francisco. The hilly terrain upon which it is built not only provides breath-taking views but also has important effects on the weather and upon neighborhood and community development. The hills channelize and restrict the summer fog with which the Pacific Coast seems to be generously blessed (?) into the western areas of the city so that while the downtown area is bright and sunny (although cooled by the ocean breezes) the beach areas will be covered by a thick pall of cool gray mist. These climatic conditions give rise to San Francisco's title of the "air-conditioned" city since its temperature range rarely hits either the freezing point or 85° and there are many winter days that are warmer than some of those in summer. The ocean breezes restrict "smog" days to only one or two a year and those of mild intensity only. Historically, September, the convention month, has the best weather of the whole year.

Administration

The paradoxes previously noted also extend into the city government of San Francisco. The administration is divided broadly into two classifications: activities which are intended to reflect changes in the moods of citizens; activities which should be conducted upon business principles and not reflect moods of the people. Those departments which should be orientated toward the feeling of the public have been placed under a Mayor and have policy determination made by lay commissions meeting at regular intervals. The business departments are supervised by an official known as the Chief Administrative Officer who appoints individual department heads. The Chief Administrative Officer, who is appointed by the Mayor when a vacancy occurs, can only be removed from office by the Board of Supervisors on charges of malfeasance and is appointed for life.

Traffic Engineering in San Francisco, unhappily, is split between the two sections of City Government with one unit having the budget and practically all the engineering

Fig. 4
Dainty — but it works!

Fig. 5
Off center center-lines are often used when one way streets are not practical.

help located in the Department of Public Works under the Chief Administrative Officer and the other having the authority located in the Police Department under the Mayor's office. Routine staff meetings have helped to reduce the difficulties inherent in such a split of functions, but much room is left for improvement. At present, however, the entire traffic administration field is being studied by the Automotive Safety Foundation with the view of improving the administrative picture.

Now don't let this division of traffic engineering functions mislead you. In addition to a wonderful social time and enlightened technical sessions, there are a great variety of traffic engineering techniques to be seen in San Francisco. We feel that most of these applications are good, a few are not, but all visitors are welcome to see and have explained both the good and bad.

Traffic Signals

The city by the Golden Gate has many different types of traffic signal operations most of which work well, some fairly well and some which are experimental. If the conventioneer can make it to San Francisco this year, he may still see some of the old Wiley signals dating back to 1927 which seem to be the result of the mating of a Chinese pagoda and a canary cage and which soon will be a thing of the past (Fig. 1).

Something which will not be a thing of the past are the unique and special traffic signal control measures needed for San Francisco's famous cable-cars. These cars of necessity must load within the intersection on some of the steeper hills that they traverse because once stopped on these hills they have only the choice of sliding backwards down to the next intersection before starting up again—a rather dangerous procedure. Because of this, the cable-cars require pre-ëmpting of traffic signals at these intersections. The intersections, however, are also part of a progressive signal network so when it came to tying in these pre-ëmpting circuits with the network, a complicated problem arose.

The system works fairly satisfactorily but there is room for improvement. It is right outside the convention hotel—how about telling San Francisco how to make it better?

Some of the more routine type of signal operations in the fixed time field are single, double and triple alternate progressive systems; pedestrian scramble signals; signals with special pre-ëmpts and cross bucks for transit control; multi-phase and split-phase signals.

In the actuated field there are semi-actuated, full actuated and volume density dispatchers in both two and three-phase systems; cycle-offset selector systems on both a single street and a network of fifty intersections; and semi-actuated signals supervised by fixed time master controllers and by volume-density dispatchers.

Traffic Signs

Of possible interest will be a system of record keeping and ordering of traffic signs by IBM. San Francisco has installations of peak hour "No Left Turn" signs in both plain porcelain enamel signs and neon internally illuminated signs. One system of plain enamel signs prohibits left turns in one direction during the morning peak and in the other direction during the evening peak and the signs are never changed. Of interest also, might be the yield signs and the excessive number of stop signs in San Francisco. These stop signs, many of them politically inspired, are so numerous that they have developed a spirit of contempt in the motorist; in many cases, the motorists shift only into second gear. It is believed that bad examples such as this would be a good selling point for traffic engineers in fighting the installation of excessive stop signs.

One-Way Streets

San Francisco has approximately 65 miles of one-way streets located mostly in the downtown area. With the good signal progression that is usually possible on these streets, they have become very popular avenues of travel.

Probably unusual is the method used in off-setting a pair of one-way streets one block. In order to provide good terminal connections at both ends of a one-way street couplet, it was necessary to shift inbound Oak Street one block north to Fell Street as shown in the accompanying photograph (Fig. 2). This was accomplished by routing over the north-

Fig. 6
Pedestrian barricade enforcing crosswalk removal at a point of high vehicular turning movement.

Fig. 7

"Walking man from here across street not allowed" says the Chinese traffic sign.

bound one-way Franklin Street. It perforce generated very heavy turning movements and very heavy lane volumes where the shift took place. However, by prohibiting pedestrian movements in certain crosswalks and retiming traffic signals, the movements take place with little delay to the motorist.

Also available are many examples of simplifying complicated intersections and reducing conflicts by one-way treatment of intersecting streets. Market Street, the main business street has at least ten such intersection treatments, no two of which are the same.

Channelization

There are many different examples of separation of vehicles by space through use of channelization. This channelization utilizes solid concrete islands, raised pavement bars and painted lines. Examples are present where all three materials are combined as well as where all three are used alone.

While channelization is often used to sort out different traffic movements for special control by traffic signals it is also used in many instances for the express purpose of avoiding or deferring signal installations. There are over 30 miles of center island and over 130 intersections with special types of channelization (Fig. 3).

Pavement Painting

Many different examples of traffic engineering with paint can be seen. Offset center lines creating more capacity in one direction than in the opposite; special lanes permitting traffic to move against one-way traffic; narrow lanes which accommodate peak hour passenger car loads but which are not intended for or respected by heavy truck traffic in lighter off-peak periods; lanes which are used for parking in other than peak periods; guide lines which encourage use of right turn lanes and many other examples of engineering techniques for increased traffic capacity by use of paint alone will be available for inspection (Figs. 4 and 5).

The painting program within the 42 square mile area includes the painting of 2,295 intersections and the striping of 190 miles of streets.

Pedestrian Control

Many types of special pedestrian control are available for inspection (Figs. 6 and 7). Curb side pedestrian barricades, both permanent and portable; center island pedestrian fences; "walk"—"wait" signals; pavement level "safety islands"; signal timing to "jump" pedestrians from island to island across the street; and "scramble" can all be seen. Some of these examples work well, others only fairly well and some such as "scramble" which, while liked by the public, are definitely inefficient under conditions in San Francisco.

Towaway

There are over 38 miles of towaway streets in San Francisco which, on the whole, have been justified by "before and after" studies. Towaway, when introduced, applies to all vehicles and is effective usually for either or both peak periods, 7:00 to 9:00 A.M., and 4:00 to 6:00 P.M. (Fig. 8).

(Concluded on page 538)

Fig. 8

No stopping in tow away zones provides additional peak hour lane.

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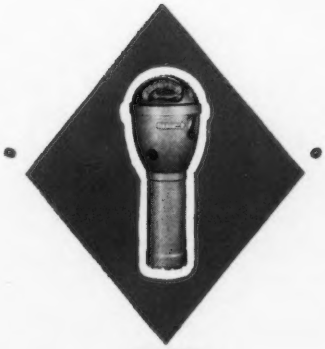

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Fig. 9
Concentric circular ramps serve 1500 stalls for self-parking.

TRAFFIC ENGINEERING IN SAN FRANCISCO

(Continued from page 536)

Off-Street Parking

Off-street parking, under the direction of the Parking Authority, has been guided toward encouraging development by private interests. While there are a number of large facilities under way at the present time, the garages of most interest are Union Square, completely underground; St. Mary's Park, partially underground, and Downtown Center Garage, entirely above ground. The latter is on privately owned property, is self-parking and features an eleven floor concentric circular entrance and exit ramps (Fig. 9). The capacities are 1,500, 1,025 and 1,150 vehicles, respectively.

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Moving Vehicle Method of Estimating Traffic Volumes and Speeds

By William J. Mortimer

Superintendent, Cook County (Ill.) Highway Department

TECHNIQUES IN traffic engineering are constantly being improved. Each such improvement adds to the collection of tools for establishing sound highway programs. No new technique is of real value unless it features significant advantages over the old.

Traffic volumes for use in highway planning are obviously important. To realize such information quickly and economically is of equal importance.

The moving car method is offered as a means for estimating traffic volumes and speeds quickly, economically and accurately.

This study was conducted by the Traffic Engineering Division of the Cook County Highway Department and is an extension of work first done by John Wardrop and George Charlesworth of the Institution of Civil Engineers, London, England. Copies of this publication are still available and can be obtained by writing to William J. Mortimer, Superintendent of the Cook County Highway Department, 130 No. Wells Street, Chicago, Illinois.

The main objective of this study was to test the feasibility of a method of estimating traffic volumes on urban streets by use of extremely short counts taken from a moving vehicle.

The moving car method under study here, requires the use of a car, a driver, and one or more observers. The number of observers is dependent upon the details sought. In this study it was found that one observer was sufficient, as no breakdown of vehicular types was attempted.

In this method, as the moving car unit travels a sector of highway under study, the observer records the stop watch time required to drive the section, the vehicles moving in the opposite direction and met by the moving car unit, the vehicles overtaking the moving car unit, and the vehicles passed by this moving car unit.

These observations are the basis for the estimates of traffic volumes and velocities of the highway section traversed.

If it is desired to classify vehicles by types, this can also be done. Where the types of vehicles are to be classified, a larger sampling time is necessary in order to maintain accuracy of estimates. To demonstrate how this works, suppose a sample is being taken on a section where the flow is ten vehicles per minute. If it is desired to make an estimate of the flow which will be within plus or minus 10% two-thirds of the time, then the sampling time must be ten minutes or more. Suppose, however, that it is desired to estimate truck traffic flow, as a breakdown of total flow, then to get the same degree of accuracy would require a much larger sample. For example, if truck traffic represented twenty per cent of the ten vehicles per minute, then to get accuracy plus or minus ten per cent in two-thirds of all cases a sampling time of over one hour would be required. In general, it would not be practical to sample for this long a period so that a lesser degree of accuracy is accepted.

Where sampling is being done on several sections from which the estimates are to be added, the accuracy is increased the same as if the added times of all sections represented a single sample time for one section. The adding of estimates would be necessary when computing vehicle miles travelled for a number of sections. The over estimates tend to be cancelled out by the under estimates.

Included in this study were ten road sections. In selecting this network of sections, an attempt was made to include a variety of road types containing a significant difference in traffic volumes and land use. Two cars traveling in opposite directions were used for the study, each car containing a

DATA SHEET

RECORDER Charles Klopp

DAY AND DATE Monday 6/6/55

SECTION Crawford Ave., Rocky Rd. to Howard St.

LENGTH .50

DIRECTION North

Time of Day	Time (Minutes & Seconds)	Vehicles Met from Opposite Direction	Vehicles Overtaking Test Car	Vehicles Passed by Test Car
10:21	0'59"	17	0	2
10:49	0'53"	12	0	0
11:18	0'58"	18	0	1
11:40	1'09"	10	0	0
12:45	0'57"	11	0	1
1:20	1'14"	10	1	1
1:47	1'00"	12	0	1
2:18	0'57"	10	0	0
2:42	0'57"	22	0	1

Fig. 1

Field data sheet for moving vehicle method of estimating traffic volumes and speeds.

driver and one observer. This was found sufficient to obtain the desired details.

No special instructions were given the driver other than to observe traffic rules and regulations. At the end of the designated road section the observer ceases to count and records the totals on the data sheet.

To avoid loss in vehicles counted, the counting was done from the center of the intersecting streets at each end of the section.

One of the sections contained a railroad crossing at grade. The recorders were instructed to keep the stop watch running while awaiting the crossing of trains and then to count the accumulated vehicles. Failure to keep time running would heavily bias the estimated volume if the accumulated cars were then counted.

During the test period, the mechanical traffic counting machines were maintained to an accuracy $\pm 3\%$ by regularly scheduled fifteen minute manual counts. For each five hour test period, there was a minimum of four such fifteen minute manual checks for each machine.

Each car starting at an opposite end of the test grid traveled through each of the ten sections nine times during each of the five test days. This resulted in 90 vehicle runs per section, or a total of 900 runs for the ten sections.

The data obtained from the above described technique is sufficient for estimating both traffic volume and speed for the section. The five hour period from 10:00 A.M. to 3:00 P.M. was chosen for this study because the traffic flow in that period is generally quantitively uniform. There is a direct relationship between these five hour traffic volumes and the total 24 hour volumes. In the study area these five off peak hour volumes were found to be approximately one fourth of the 24 hour totals. Expansion to 24 hour volumes on the basis of this relationship introduces additional random errors, so that for this study only the five hour estimates were used.

It seemed likely that the flow of traffic in this period was Poisson distributed so that the volume in any given sized interval would have a mean and variance equal to $n \cdot t$
where
n = average volume per minute
t = minutes of time interval

This conformity to the Poisson distribution was tested for fifteen minute intervals by the use of Chi square. For each section the five hours were divided into twenty, fifteen minute periods, with mean equal to $\frac{\text{5 hour volume}}{20}$. For each mean fifteen minute volume a Poisson series was determined, the observed frequencies were paired with the expected Poisson frequencies, and the value of Chi square determined. The results indicated quite conclusively that the hypothesis of Poisson distribution could reasonably be accepted.

It is desired to estimate the five hour volume from a sample of t minutes with n vehicles per minute. Under the Poisson assumption, the mean of the estimate will be $\frac{300}{t}$ $(n \cdot t)$ and the variance $\frac{300^2}{t^2}(n\ t)$ or the standard error

$$= \sqrt{\text{variance}} = \sqrt{\frac{300^2 (nt)}{t^2}} = \frac{300\sqrt{nt}}{t}$$

which reduces to $300/\sqrt{\frac{n}{t}}$. If it is necessary to study the ratio of the standard error to the 5 hour volume, the standard error is divided by 300 n and the result is:

$$k = \frac{1}{\sqrt{n\ t}}$$

$$\text{where } k = \frac{\text{standard error of the 5 hour estimate}}{\text{5 hour actual volume}}$$

This k is referred to as the relative standard error, or coefficient of variation.

$\frac{300}{t}(n\ t)$ and the variance $\frac{300^2}{t^2}(n\ t)$. The standard error

The family of curves titled "Poisson relationship of traffic volume and relative standard error to required sample time in estimating 5 hour volume" can be used to find the theoretical sampling time required when the 5 hour volume and relative standard error are specified.

These curves were used in the study of the moving car method and comparisons are made with this family of curves and those curves actually found in the study. These comparisons are discussed in the following section on analysis of field data.

It should be pointed out that these Poisson curves are not limited to use with the moving car method, but can be used with any sampling technique for this five hour period, or can easily be adjusted for use within any time period where traffic flow conforms to the Poisson distribution.

As an illustration of how to use the curves in Figure 2, suppose sampling is to be done on a section with a volume of 1,500 vehicles in the designated five hour interval. It is desired to estimate this volume with a relative standard error of .15. To determine the necessary sampling time, locate the intersection of 1500 on the horizontal scale with .15 on the vertical scale. This is seen to lie on the curve t=10, so that sampling must be done for 10 minutes.

This particular use can only be made if some rough estimate of volume is known prior to the completion of sampling. In a normal use of the method where no estimate of volume was available, sampling would proceed for some prearranged time period and then after the estimate was obtained, the curves could be used to determine relative standard error. For example, suppose an estimate of 3,000 vehicles is arrived at in a sampling time of three minutes. Standard error should be about 18%. This can be interpreted as meaning that two thirds of the time the true volume will be bracketed by the interval plus and minus 18% around the estimated volume.

The estimates of two directional flow were obtained from the formula

$$V = \frac{M + (O\text{-}P)}{t}$$

Where V = estimated two directional flow per minute
M = vehicles met from opposite direction
O = vehicles overtaking the test car
P = vehicles passed by the test car
t = time of the run in minutes

If the directional flows for any given section are equal, then as little as one run in either direction can be used for estimating the desired volume. In the ten sections under study, for the five off peak hours, the directional flows were

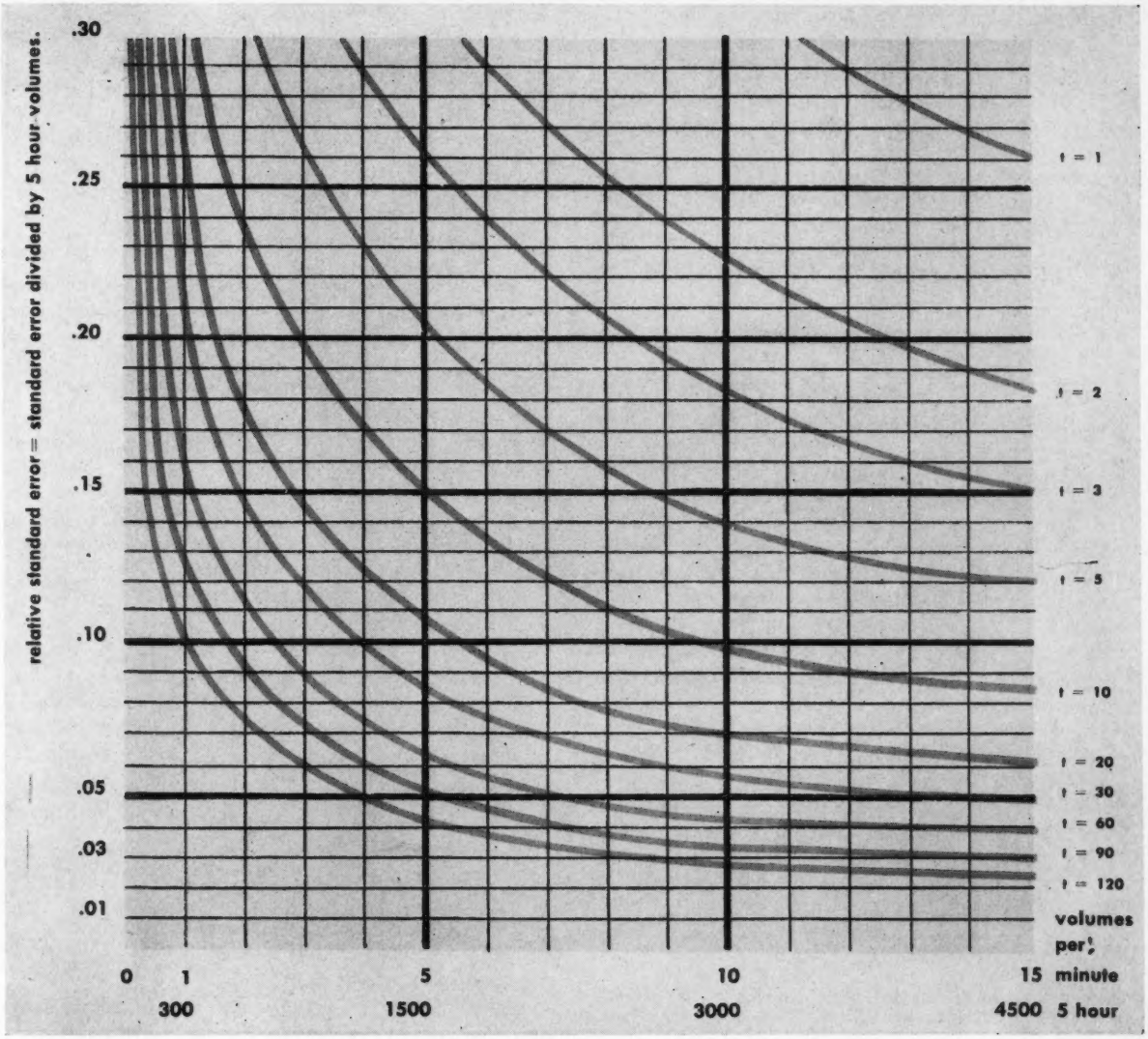

Fig. 2

Poisson relationship of traffic volume and relative standard error to required sample time in estimating 5 hour volumes.

found not to be significantly different. Application of the above formula to the data from one run in either direction was found to give an unbiased estimate of the two directional volume. This obviously would not be true when the directional flows differed and if total two way volume were desired in such a case an equal number of runs would have to be made in each direction and the estimate made from the combined total. One directional flow can also be studied, but this involves a slightly different formula.

The flow per minute in one direction may be obtained from the following formula:

$$V = \frac{M_a + O_w - P_w}{t_a + t_w}$$

where M_a = vehicles met when traveling against the flow
O_w = vehicles overtaking the test car when traveling with the flow
P_w = vehicles passed by the test car when traveling with the flow
t_a & t_w = time required to drive the section when traveling against and with the flow.

Speeds

Suppose it is required to estimate the average speed of traffic for both directions on a given section of road. The average time required to drive through the section in each direction must first be computed.

This is found to be

$$t_r = t_1 + t_2 - \frac{(O_1 + O_2 - P_1 - P_2)}{V}$$

where t_r = driving time for a round trip
t_1 = driving time for one direction
t_2 = driving time for other direction

O_1 & O_2 = vehicles overtaking test car while traveling in directions 1 and 2 respectively

P_1 & P_2 = vehicles passed by test car while traveling in directions 1 and 2 respectively

V = two directional estimate of traffic flow per minute

It is a simple matter to convert the driving time to speed. One directional speed can also be studied by use of this method, but for this study the uni-directional speeds were assumed equal. This assumption was tested over the ten sections under study and found acceptable.

The average speed of traffic for use as control was found by two methods:

1) the radar tested speed across a given point.
2) the time required for a vehicle to travel the entire section as measured by standing observers at each end of the section, using synchronized stop watches. A 20 per cent sample was taken and vehicle identification was accomplished by the license plate method.

The radar tested speed tended to be higher than the speed computed by the other method. Since the travel time for the section included stopping at the end of the section, the second method was used as the control.

The average control speed for the ten sections was 27.4 MPH and the average estimated speed 24.5 MPH. The average error of estimate was —2.9 MPH with standard deviation equal to 1.8 MPH. On the basis of these figures alone, the hypothesis of zero average error could not reasonably be rejected. However, in all ten sections, the estimated speed was found to be an underestimate of the control speed.

Referring to the formula for average time required to drive a round trip on the section,

$$t_r = t_1 + t_2 - \frac{(O_1 + O_2 - P_1 - P_2)}{V}$$

it is seen that if the test car drives the run at the average speed of all cars driving the run, then the only factor influencing the estimate of speed is the number of overtaking and passed vehicles. These are assumed to balance in the long run. However, in this study, there was a marked tendency for the number of vehicles passed by the test car to be greater than the number overtaking it. The explanation for this seems to lie in the nature of the road sections studied. In a residential, suburban, or business area, there is a tendency for vehicles to slow down to turn, park, etc. This tendency would increase the probability of the test car passing a vehicle and hence upset the balance assumed to exist between vehicles overtaking and vehicles passed by the test car. Where the number of passed vehicles is small relative to the estimated flow, the effect of this imbalance may be negligible, but where it is large (especially noticeable on low volume sections) the effect is significant, and will produce an underestimate of speed as measured by the standing observers at each end of the section.

The standing observers are only measuring the time of through traffic traveling the section. If the observer in the test car did not count vehicles he passed unless they were definitely through traffic, (omit cars parking, turning, etc.), the indicated formula should produce an unbiased estimate of the control speed.

Application and Summary

Volume counts on a street system are now secured by machine or manual counts. These existing methods require machines and manpower in various proportions. Any extensive counting program might require the use of a substantial number of men and machines not readily available.

The techniques presented in this paper will provide a method of volume counting which will require a bare minimum of manpower and equipment. It offers a means of securing economically and quickly a blanket volume count of all streets in a given area.

Such information as vehicle miles of travel on a road network, volumes over this road network, vehicle classifications and vehicular speeds, may be realized from this technique.

Comparative operating time and cost of this method over current methods will vary with specific problems, but appears to be substantially lower in many cases.

For example, a one hundred mile network of roads could be covered once by this method in less than five hours with one car and two men.

For varying total volumes of a given network, the following table indicates the standard error expected in estimating the sum of the volumes of the individual sections. This is on the basis of one covering of the network:

Table I

Sum of the volumes of the individual ½ mile sections	Expected Standard Error	Relative Standard Error
50,000	4,157	.083
100,000	5,896	.059
200,000	8,327	.042
300,000	10,203	.034
500,000	13,170	.026
1,000,000	18,630	.019

This table emphasizes the potential of the moving car method for blanketing road systems quickly, economically and accurately.

Three methods for obtaining total vehicle miles traveled were suggested in a previous paper. Each method is listed below along with the time required to obtain volume estimates for computing total vehicle miles traveled on a 100 mile network of roads (2 miles square with 25 x 25 grid of streets).

1) A six minute manual traffic count eight times a day in each block. 1650 total man hours.
2) A one hour manual count at every other intersection. 312 man hours plus travel time.
3) Mechanical non-recording counts at approximately every five blocks. 100 man hours plus 6000 machine hours.

Assume that the individual sections have 5 hour volumes of 250 vehicles or a combined total of 50,000 vehicles for 200 one-half mile sections. Then the moving car method would require 11 runs or about 96 man hours to insure against errors exceeding ±5%, but for errors ±10% only three runs would be necessary, or a total of 26 man hours.

If the individual sections have as much as 2,500 vehicles per five hour interval, then one run or less than 9 man hours would insure against errors exceeding 5.2%.

The moving vehicle method could be used to find the flow of traffic along an expressway. By traveling each direc-

tion on the expressway once or twice and letting sections be determined by ramps, a precise estimate of flow can be obtained, as well as volume estimates across particular points. This type of covering could be done for peak hours, off peak hours, etc. To obtain the same data by machine or manual counts would require many machine or man hours.

To illustrate this use, a study was done on Edens Expressway. Edens Expressway, which is about 13.5 miles in length, was divided in seven sections. Machines were placed in four of the seven sections as a check against the accuracy of the method. Four round trips, the full length of Edens, were made ,one between 7:00 A.M. and 8:00 A.M., one between 8:00 A.M. and 9:00 A.M., one between 10:00 A.M. and 11:00 A.M., and the last between 11:00 A.M. and 12:00 noon. For each section, for each direction, and for each time period, an estimate of flow was obtained. From these the vehicle miles travelled were computed, and it appears from the machine checks, that the estimate of total vehicle miles travelled should be within about four per cent of the true value.

If in an actual situation it was desired to estimate total vehicle miles travelled for a twenty-four hour period, then some relationship of the test hour to the total twenty-four hour period would have to be determined. Application of such factors will, in general, increase error of estimate, but if the increase in error is adequately offset by man hours saved, it becomes a simple matter to determine the point where maximum accuracy can be achieved with a minimum of man hours.

It should be pointed out that for the Edens Expressway example, the formula for one directional flow was used: flow per hour =

$$60\frac{M_a + (O - P)_w}{t_a + t_w}$$

Table II

ESTIMATE OF NORTH BOUND FLOW ON EDENS EXPRESSWAY

SECTION	Length in miles	Time of Day	M_s	$(O—P)_n$	$t_n + t_s$	$60\frac{[M_s + (O—P)_n]}{t_n + t_s}$		Vehicle miles traveled
Cicero Ave.-Peterson Ave.	0.6	7:00 A.M.	37	— 3	1.18	1729	Machine	1037.4
		8:00 A.M.	25	— 1	1.27	1134	Count	680.4
		10:00 A.M.	8	0	1.22	393		235.8
		11:00 A.M.	8	0	1.23	390		234.0
Peterson Ave.-Touhy Ave.	1.5	7:00 A.M.	126	—11	3.07	2248		3372.0
		8:00 A.M.	64	— 6	3.12	1115		1672.5
		10:00 A.M.	44	— 5	3.28	713		1069.5
		11:00 A.M.	55	— 3	3.50	891		1336.5
Touhy Ave.-Dempster St.	2.5	7:00 A.M.	198	— 9	5.10	2224		5560.0
		8:00 A.M.	114	— 6	4.88	1328	1312	3320.0
		10:00 A.M.	96	— 4	5.12	1078	1038	2695.0
		11:00 A.M.	102	— 7	5.47	1042	1169	2605.0
Dempster St.-Lake Ave.	2.9	7:00 A.M.	132	—14	6.05	1170	1393	3393.0
		8:00 A.M.	147	— 4	5.77	1487	992	4312.3
		10:00 A.M.	85	— 5	5.95	807	918	2340.3
		11:00 A.M.	96	— 3	6.27	890	957	2581.0
Lake Ave.-Willow Rd.	1.5	7:00 A.M.	108	— 1	3.28	1957		2935.5
		8:00 A.M.	54	— 4	2.97	1010	1133	1515.0
		10:00 A.M.	70	— 2	3.38	1207	1019	1810.5
		11:00 A.M.	55	0	4.57	722	1091	1083.0
Willow Rd.-Dundee Rd.	2.8	7:00 A.M.	100	— 5	5.55	1027	924	2875.6
		8:00 A.M.	98	— 6	5.52	1000	938	2800.0
		10:00 A.M.	94	— 4	5.67	952	983	2665.6
		11:00 A.M.	83	— 4	5.02	944	942	2643.2
Dundee Rd.-Clavey Rd.	1.8	7:00 A.M.	78	— 6	4.10	1054		1897.2
		8:00 A.M.	70	— 2	3.92	1041		1873.8
		10:00 A.M.	72	— 4	4.15	983		1769.4
		11:00 A.M.	49	1	4.38	685		1233.0

KEY:—

M_s = Vehicles met from opposite direction while test car is travelling south.

$(O—P)_n$ = Vehicles overtaking test car less those passed by test car while test car is travelling north.

$(t_n + t_s)$ = time to travel section when travelling north plus time to travel the section when travelling south.

$60\left[\frac{M_s + (O—P)_n}{t_n + t_s}\right]$ = Flow for the hour. (Northbound)

N. or S. = direction of moving vehicle test car.

Total —

7:00- 8:00 A.M.	21,070.7
8:00- 9:00 A.M.	16,174.0
10:00-11:00 A.M.	12,586.1
11:00-12:00 A.M.	11,715.7

where M_a = the vehicles met from the opposite direction while travelling against the flow

$(O - P)_w$ = the vehicles overtaking the test car less those passed by the test car while the test car is travelling with the flow

$t_a + t_w$ = time to drive the section when travelling against the flow plus time to drive the section when travelling with the flow.

Summary

1. For the five off peak hours the hypothesis of Poisson distribution of traffic flow was found acceptable.

2. The moving car method was found to produce an unbiased estimate of the five hour bi-directional traffic volumes.

3. By regression analysis it was found that the standard error of the five hour estimated volume could be reasonably determined by the relationship

$$\text{S.E.} = 1.245 \text{ Poisson's S.E.} - 4,$$

$$\text{where Poisson S.E.} = 300 \sqrt{\frac{n}{t}}$$

4. The standard error in estimating the five hour volume is sufficiently small in certain applications to consider the use of this method in preference to other existing methods.

5. It appears that an unbiased estimate of speed can be obtained from this method, but an adjustment is needed in the vehicles counted to eliminate non-through traffic. If the non-through traffic is to be counted, then the "standing observer" method does not provide an appropriate control speed.

Table III

ESTIMATE OF SOUTH BOUND FLOW ON EDENS EXPRESSWAY

SECTION	Length in miles	Time of Day	M_n	$(O—P)_s$	$t_n + t_s \frac{60[M_n + (O—P)_s]}{t_n + t_s}$			Vehicle miles traveled
Clavey Rd.-Dundee Rd.	1.8	7:00 A.M.	91	0	4.10	1332	Machine	2397.6
		8:00 A.M.	66	— 2	3.92	980	Count	1764.0
		10:00 A.M.	46	— 1	4.15	651		1171.8
		11:00 A.M.	58	— 1	4.38	781		1405.8
Dundee Rd.-Willow Rd.	2.8	7:00 A.M.	200	— 1	5.55	2151	1714	6022.8
		8:00 A.M.	150	— 5	5.52	1576	1690	4412.8
		10:00 A.M.	96	1	5.67	1026	959	2872.8
		11:00 A.M.	85	— 7	5.02	932	933	2609.6
Willow Rd.-Lake Ave.	1.5	7:00 A.M.	169	0	3.28	3091		4636.5
		8:00 A.M.	94	— 3	2.97	1838	2106	2754.0
		10:00 A.M.	63	— 1	3.38	1101	1143	1651.5
		11:00 A.M.	52	3	4.57	722	1055	1083.0
Lake Ave.-Dempster St.	2.9	7:00 A.M.	198	8	6.05	2043	1824	5924.7
		8:00 A.M.	167	— 2	5.77	1716	2108	4976.4
		10:00 A.M.	118	— 6	5.95	1129	1049	3274.1
		11:00 A.M.	81	— 3	6.27	748	935	2163.4
Dempster St.-Touhy Ave.	2.5	7:00 A.M.	260	3	5.10	3094		7735.0
		8:00 A.M.	189	— 3	4.88	2287	2554	5717.5
		10:00 A.M.	88	— 5	5.12	973	1013	2432.5
		11:00 A.M.	98	0	5.47	1075	968	2687.5
Touhy Ave.-Peterson Ave.	1.5	7:00 A.M.	114	— 5	3.07	2130		3195.0
		8:00 A.M.	98	1	3.12	1904		2856.0
		10:00 A.M.	45	— 3	3.28	768		1152.0
		11:00 A.M.	61	— 4	3.50	977		1465.5
Peterson Ave.-Cicero Ave.	0.6	7:00 A.M.	30	1	1.18	1576		945.6
		8:00 A.M.	49	— 1	1.27	2268		1360.8
		10:00 A.M.	12	0	1.22	590		354.0
		11:00 A.M.	13	0	1.23	634		380.4

KEY:—

M_n = Vehicles met from opposite direction while test car is travelling north.

$(O—P)_s$ = Vehicles overtaking test car less those passed by test car while test car is travelling south.

$(t_n + t_s)$ = time to travel section when travelling north plus time to travel the section when travelling south.

$60 \left[\frac{M_n + (O—P)_s}{t_n + t_s} \right]$ = Flow for the hour. (Southbound)

N. or S. = direction of moving vehicle test car.

Total —

7:00- 8:00 A.M.	30,857.2
8:00- 9:00 A.M.	23,841.5
10:00-11:00 A.M.	12,908.7
11:00-12:00 A.M.	11,795.2

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What Should the Maximum Speed Limit Be?

By Matthew C. Sielski, (Mem., ITE)

Director Safety & Traffic Engineering Dept., Chicago Motor Club

Introduction

HIGHWAY SPEEDS today are receiving attention by many organizations and individuals who are concerned over the high accident rates. No one will deny the need for restricted speed limits at many locations. They are necessary for the safe and convenient movement of vehicles. But, in an attempt to provide traffic safeguards through speed limits, restrictions are frequently effected which do not contribute to safety and expeditious movement, and which unnecessarily hamper the driver.

Because of the attention being focused on this matter, we have undertaken a study to determine if need for an overall maximum speed limit exists, and if so, what this limit should be.

We wish to extend our thanks to agencies of the states of Wisconsin, Indiana, Michigan and Illinois which furnished data used in this study, and to Traffic Control Corporation for use of their radar speed meter.

Just what are we trying to accomplish?

It is the sincere desire of nearly all people to conserve life and property on the highway. This desire is indicated through safety campaigns of one type or another, and in legislation which requires motorists to conform to a safe pattern of driving behavior. Faith in the results that will be obtained through legislation, however, is too frequently based on opinion and not on fact.

Factual data on which to base open highway speed regulations is almost universally unavailable. From figures published by various agencies, it is very easy to conclude that by reducing the speed limits the accident rate will be reduced. Unfortunately, seldom is this conclusion substantiated.

We are trying to save life and property. We have been led to believe that high speed is responsible for high fatalities and property loss. But, are we sure speed is responsible?

Usually when speed is involved in accidents, it is classified as "too fast for conditions." This may mean that a vehicle traveling at 30 m.p.h. may have been traveling "too fast for conditions" and consequently could not be classified as "high speed." The general belief, however, is that *speed was the cause and therefore the need of a fixed top limit!* As a matter of fact, the majority of accidents involve vehicles traveling between 30 and 60 m.p.h., and that there are as many fatalities caused by vehicles traveling under 30 m.p.h. as there are traveling over 60 m.p.h.

Accident Records

Because of the unreliability of accident reporting, it is difficult to find the effect of vehicular speed on the accident rate. Reporting officers' lack of training accounts for the ambiguity of "excessive speed," "too fast for conditions," "exceeding posted speed limits," etc., usually found on report forms. In addition, most agencies compiling accident data do not indicate actual vehicle speeds at the time of the accident.

The National Safety Council in its 1955 edition of "Accident Facts" indicates that in 23 states 21% of rural fatal accidents were attributed to vehicles exceeding speeds of 60 m.p.h. The following table gives the percentage distribution among various speeds of vehicles in rural accidents:

Rural—from 0 to 30 m.p.h.	19%
Rural—from 30 to 60 m.p.h.	58%
Rural—over 60 m.p.h.	21%

Thus, it can be seen that the majority of accidents on our rural highways occur between 30 and 60 m.p.h.

In a further effort to find the effect of speed as a cause of accidents, we compared in the various states the rural death rate per 10,000 vehicles with their maximum speed limits (see Table I). It will be shown that Illinois, Michigan, Iowa and Missouri, where no maximum speed limit existed in 1954, had a lower fatality rate than Minnesota, Wisconsin, Indiana, Kentucky and Ohio, where fixed limits existed. The average death rate in the states where speed limits existed was 5.0 as compared to the states with no limit which was 4.9. Actually, on an individual basis, with the exception of Kentucky, all the states had approximately the same death rate which indicates that the placement of speed limits had no basic effect.

As has been previously stated, no information is available in Illinois indicating the number of fatalities caused by vehicles traveling at high speeds. The only indication of speed is the factor indicated by "too fast for conditions." However if it is assumed, as stated by the National Safety Council, that 21 per cent of deaths in rural accidents are caused by vehicles traveling over 60 m.p.h. then 21 per cent of the "too fast for conditions" fatalities would amount to 217 or 4 per cent of all rural fatal accidents. This seems to be a logical explanation for the similarity in death rates for the various states operating at different speed regulations.

Actually, as the statistics above indicate, it is a combination of several contributing factors that lead to accidents. For example, one car passing improperly during adverse weather conditions while approaching another vehicle traveling too fast for conditions sets the stage for a serious accident. It is the combination of contributing factors that makes it difficult for traffic experts to pin-point the real cure for accidents. Speed is a contributing factor, but to what degree is still an uncertainty. In order to delve into this a little further, speed studies compared the effect of top speeds where fixed limits exist and where no limits are posted.

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TABLE I
1954
Rural Death Rates & Speed Limits in 1954 in Various States

	Rural Death Rate (deaths per 10,000 vehicles	Speed Limit Day	Speed Limit Night	Absolute or Reasonable
Alabama	6.9	60	50	R
Arizona	9.5	none	50	R
Arkansas	6.5	60	60	R
California	3.8	55	55	R
Colorado	4.8	60	60	R
Connecticut	1.7	45	45	R
Delaware	5.6	55	55	A
Florida	5.2	60	50	R
Georgia	6.5	60	50	A
Idaho	7.4	60	55	R
Illinois	4.5	none	none	R
Indiana	5.0	65	55	R
Iowa	4.4	none	none	-
Kansas	5.6	none	none	R
Kentucky	7.1	60	50	A
Louisiana	—	60	60	R
Maine	3.7	45	45	R
Maryland	4.2	55	55	R
Massachusetts	1.0	40	40	R
Michigan	4.5	none	none	-
Minnesota	3.7	60	50	R
Mississippi	6.8	60	60	A
Missouri	5.3	none	none	-
Montana	6.4	none	55	R
Nebraska	4.4	60	50	A
Nevada	12.3	none	none	-
New Hampshire	3.5	50	50	R
New Jersey	—	50	50	A
New Mexico	11.2	60	55	R
New York	2.6	50	50	A
North Carolina	6.2	55	55	A
North Dakota	4.7	50	50	R
Ohio	4.1	50	50	R
Oklahoma	5.3	65	55	A
Oregon	4.4	55	55	R
Pennsylvania	2.6	50	50	A
Rhode Island	0.2	50	45	R
South Carolina	7.0	55	55	R
South Dakota	5.4	60	50	R
Tennessee	5.4	none	none	R
Texas	5.4	60	55	R
Utah	5.1	60	50	R
Vermont	5.0	50	50	A
Virginia	5.7	55	55	A
Washington	2.8	50	50	A
West Virginia	6.0	55	55	A
Wisconsin	5.1	65	55	A
Wyoming	8.3	60	60	R

In studying past accident records in Illinois, the following table was compiled which indicates many of the causes of accidents on rural highways in Illinois:

Apparent Cause of Rural Accidents
State of Illinois

	1950	1951	1952	1953	1954	Total	%
Driver had been drinking	58	43	36	48	55	240	5
Too fast for conditions	168	189	216	221	240	1,034	20
Did not have right-of-way	40	29	49	50	76	244	5
On wrong side of road	116	114	88	94	89	501	10
Improper passing or turning	37	52	56	56	64	265	5
Inattention	49	45	36	71	112	313	6
Reckless driving	96	118	170	186	172	742	15
Disregarded sign or signal	101	86	88	81	114	470	9
Accident due to pedestrian	82	87	99	111	86	465	9
Miscellaneous	178	158	185	163	95	768	16
TOTAL	914	921	1,023	1,081	1,103	5,042	100

Vehicular Speeds on Rural Roads

To obtain an intelligent answer to this question, data was obtained from the various state highway departments together with radar studies made by the Chicago Motor Club Engineering Department. The following studies were reviewed:

1. "Report of Speeds at High Speed Locations on Illinois Rural State Highways," published by Bureau of Traffic, Illinois Division of Highways, February 15, 1956.

2. "Traffic Speed Study, State Highway Commission of Wisconsin, May, 1955."

3. "Traffic Speed Trends," Bureau of Public Roads.

4. "Comparison of Speeds on the Rural State Trunkline System Before and After Enactment of the 65-55 m.p.h. Speed Law." Michigan State Highway Department, April, 1955 - April, 1956.

Here is the comparison of the speeds in the four midwestern states:

State	Type of Speed Law	Average Speed	85% Speed
Michigan	65-55	54.3 m.p.h.	62.5 m.p.h.
Indiana	65-55	54.1 m.p.h.	63.5 m.p.h.
Wisconsin	65-55	55.9 m.p.h.	63.9 m.p.h.
Illinois	Reasonable	54.9 m.p.h.	63.1 m.p.h.

From this study it is apparent that the speed characteristics of these states is approximately the same regardless of the type of regulation in effect.

To get a closer relationship of the speed characteristics of motorists traveling on roads with and without top speed limits, a comparison was made of highways passing from one state to another under almost identical physical conditions, with one exception—no limit compared to a 65 m.p.h. limit.

Comparison of Speeds in Illinois and Wisconsin

The first test involved U. S. 41, a divided four-lane highway very similar in character in both Illinois and Wisconsin.

The Illinois check was made by the Illinois Division of Highways at approximately 14 miles south of the Wisconsin border. The Wisconsin survey made by the Wisconsin State

Highway Commission was conducted approximately seven miles north of the Illinois border. It showed the following:

		Average Speed	85% Speed
U. S. 41	Wisconsin	60.4 m.p.h.	67.7 m.p.h.
U. S. 41	Illinois	50.8 m.p.h.	59.0 m.p.h.

A similar study was made by Motor Club engineers on December 7, 1955, and indicated the following: (see Figure 1)

		Average Speed	85% Speed
U. S. 41	Southbound, Wis.	55.7 m.p.h.	62.0 m.p.h.
U. S. 41	Northbound, Ill.	49.5 m.p.h.	58.0 m.p.h.

The second study was made on a two lane highway, U. S. 14. The Illinois check was made by the Illinois Division of Highways, and the Wisconsin study by the Wisconsin State Highway Commission. The survey of U. S. 14 in Illinois was taken about 18 miles south and the Wisconsin check at about five miles north of the border.

		Average Speed	85% Speed
U. S. 14	Wisconsin	54.8 m.p.h.	63.0 m.p.h.
U. S. 14	Illinois	49.9 m.p.h.	56.8 m.p.h.

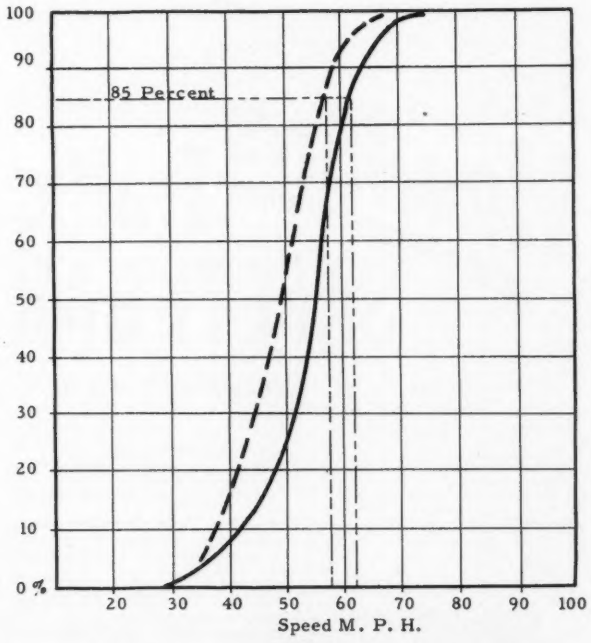

Fig. 1
Comparison of Spot Speeds on US 41 in Wisconsin and Illinois in 1955.

4 Lane Divided Pavement—
State Speed Limit—65 M.P.H.
WIS. ———— 85 Percentile Speed—62 M.P.H.
Median Speed—55.7 M.P.H.

ILL. – – – – 4 Lane Divided Pavement,
No Speed Limit
85 Percentile Speed—58 M.P.H.
Median Speed—49.5 M.P.H.

Survey taken 2-7-55

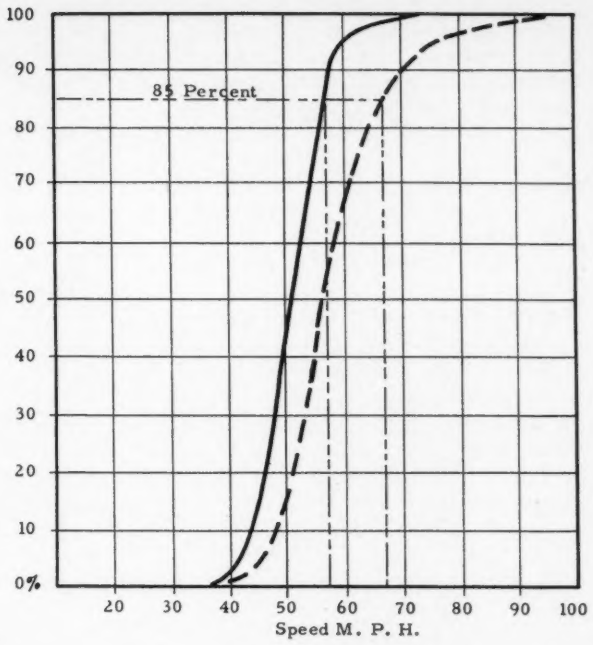

Fig. 2
Comparison of Spot Speeds on US 41 in Indiana in 1953 and 1955.

Survey taken 3-11-53. No Speed Limit
———— 85 Percentile Speed—56.5 M.P.H.
Median Speed—50 M.P.H.
– – – – Survey taken 12-12-55.
State Speed Limit 65 M.P.H.
85 Percentile Speed—66.5 M.P.H.
Median Speed—56.0 M.P.H.

The following information is also available, illustrating the average speed of passenger cars on rural highways in Wisconsin over a period of 11 years:

Date	No. of Locations	Average Speed
1945	4	47.3
1946	15	47.8
1947	15	48.4
1948	15	48.3
1949	13	49.9
1950 (65 m.p.h. fixed limit into effect)	7	51.3
1951	7	50.6
1952	15	52.7
1953	15	53.4
1954	15	54.0
1955	15	55.9

Comparison of Speeds in Illinois and Indiana

A posted limit of 65 m.p.h. was established in Indiana in the summer of 1953. Prior to the posted speed limit, Chicago Motor Club engineers made studies on Indiana U. S. 41. The same location was studied after the speed limit was established, and following are the results: (See Figure 2)

	Average Speed	85% Speed
4-11-53 (before)	50.0 m.p.h.	56.5 m.p.h.
12-12-55 (after)	56.0 m.p.h.	66.5 m.p.h.

Club engineers compared the speeds of traffic traveling towards the Illinois-Indiana border on U. S. 24. This highway is very similar in character, except for a posted 65 m.p.h. in Indiana and no speed limit in Illinois. Both studies were taken on the same day. (See Figure 3)

	Average Speed	85% Speed
Indiana U. S. 24 (3 miles east of border)	53.0 m.p.h.	59.2 m.p.h.
Illinois U. S. 24 (4 miles west of border)	49.0 m.p.h.	58.5 m.p.h.

Michigan Experience with Rural Speeds

The Michigan State Highway Department, in its efforts to determine the effect of its 65 m.p.h. limit took comprehensive studies before (April, 1955) and after (April, 1956) the speed limit went into effect. In its published report is the following resume:

Comparison of Average Speeds on Rural State Highways

	All Vehicles	Passenger Cars	Commercial Vehicles	Buses
Before	51.9 m.p.h.	53.8 m.p.h.	45.1 m.p.h.	54.0 m.p.h.
After	52.7 m.p.h.	54.3 m.p.h.	45.8 m.p.h.	57.2 m.p.h.
Vehicles traveling over 60 m.p.h.				
Before	18.4%	23.1%	1.9%	18.2%
After	20.6%	25.3%	1.6%	31.4%
Vehicles traveling over 65 m.p.h.				
Before	8.0%	10.3%	0.3%	6.1%
After	7.7%	9.5%	0.1%	20.0%

6,388 vehicles were observed in 1955 and 5,705 in 1956.

CONCLUSIONS

On the basis of studies made, the following conclusions are reached:

1. Very few passenger cars travel at speeds higher than 65 m.p.h. regardless of speed regulation.

2. The average speed is increased where a fixed speed is incorporated.

3. There is no correlation between accident rate and top speed regulations.

4. Only 4 per cent of fatalities on rural highways, *where speed is the apparent cause,* is caused by vehicles traveling over 65 m.p.h.

5. Most motorists drive at a reasonable and proper speed and are capable of recognizing conditions that warrant lower speeds. The minority who wish to travel at reckless speed must be dealt with firmly but not at the expense of the majority of good drivers. Police authorities must improve selective enforcement in order to correct the violations that are contributing to accidents.

1955 PROCEEDINGS

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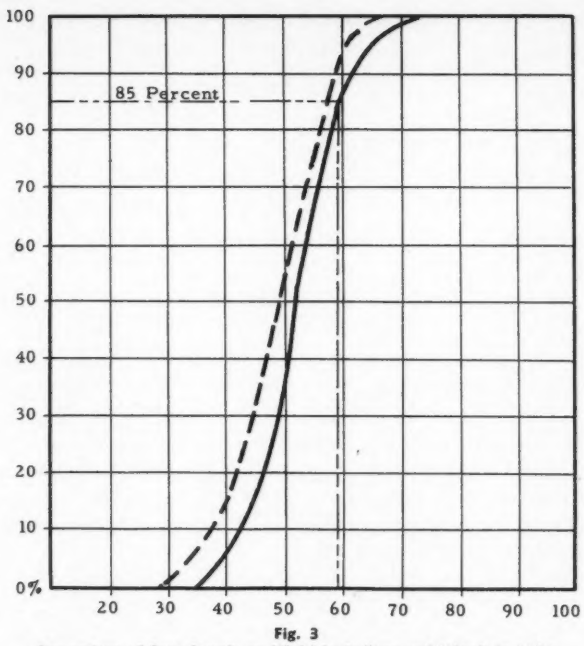

Fig. 3
Comparison of Spot Speeds on US 24 in Indiana and Illinois in 1956.

IND. ——— 85% speed=59.2 Average speed=53.0
ILL. — — — — 85% speed=58.5 Average speed=49.0

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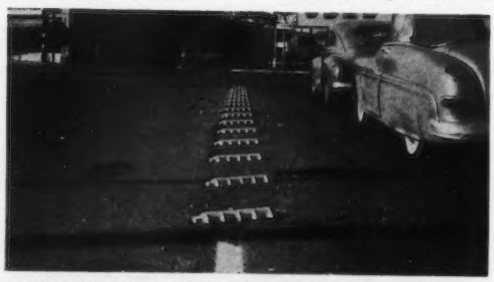

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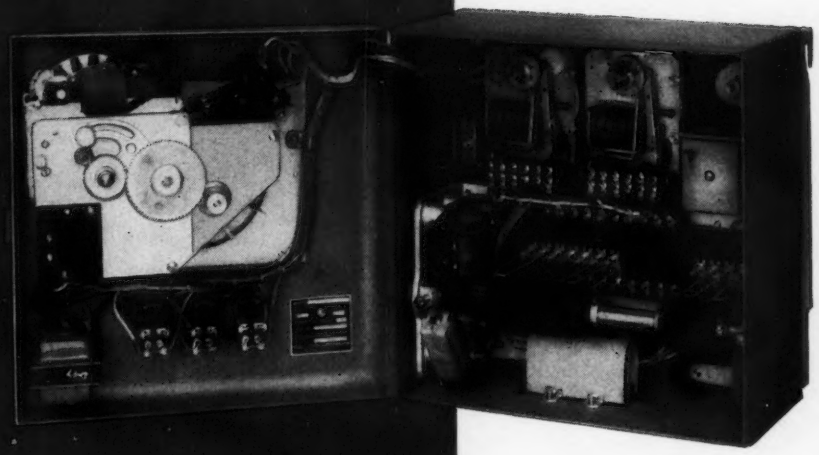

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Mass Transit in the Bay Area

By Eric A. Mohr, (Assoc. Mem., ITE)

Associate Transportation Engineer, California Public Utilities Commission

SAN FRANCISCO, host city for the ITE's national meeting in September 1956, is more than a large and colorful city; it is the heart of one of the nation's great metropolitan areas. San Francisco and the Bay Area share with other metropolitan areas the existence of serious transportation problems. Other articles in TRAFFIC ENGINEERING describe the contributions made by the California State Division of Highways and by traffic engineers of San Francisco and other Bay Area cities towards solution of the problems. Activities of state and municipal traffic engineers are directed primarily towards improvement of the street and freeway system. They have been of great benefit to that system's primary user, the private motorist, who, in providing individual transportation for himself and his 0.7 passengers, satisfies the major share of the area's transportation needs. The remaining need for the transportation of persons is filled mainly by the various mass transit systems of the Bay Region. This article describes systems presently operating in the area and includes glances into past and future.

The Bay Area offers an interesting and varied transit picture today, with equipment ranging from cable car and ferry boat to double-deck commuter cars. The future of Bay Area transit has been studied intensively during the past years, and a comprehensive plan for an entirely new, modern rapid transit system has been completed.

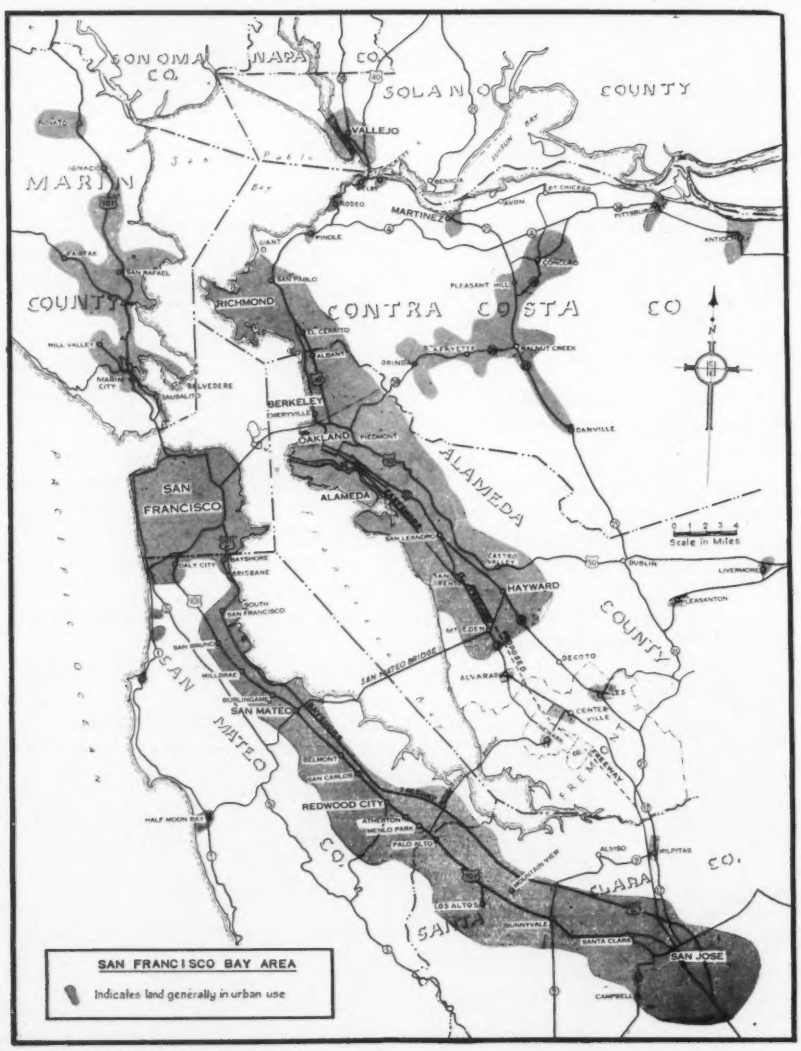

Fig. 1
The San Francisco Bay Area showing population concentration.

Background

There are a number of characteristics of postwar growth common to the major metropolitan areas in the United States and important to mass transportation:

1. Substantial population increases, more rapid in the suburbs than in the central cities
2. Increases in automobile registration at a faster rate than population growth, and in the mileage per vehicle per year
3. Trend towards single family dwellings, resulting in low population densities in outlying areas
4. Growth of suburban shopping and manufacturing centers

These characteristics have been described in detail in traffic engineering and city planning literature, and their discussion need not be repeated here. The San Francisco Bay Area has experienced increases in automobile registration and single family dwellings with particular sharpness. In addition, three other characteristics should be noted, not generally present in metropolitan areas:

1. Most major cities are located on rivers, lakes or oceans, but few have as large a body of water as San Francisco Bay included in their metropolitan area, requiring tremendously long and costly crossing facilities.
2. Most metropolitan areas are dominated by a single central city. In the Bay Area, there are two major cities, San Francisco and Oakland, both with substantial downtown districts serving as focal points for mass transportation.
3. Many metropolitan areas can grow radially in many different directions, and ever greater areas of residential and other land are available with each additional mile of distance from the center. In the Bay Area, topography limits residential growth largely to ribbons of flat land and gentle hills located between the waters of the Bay and the steep rugged hills paralleling its shores.

The development of the Bay Area has created several major and minor concentrations of population bordering the Bay, shown on figure 1.

Major concentrations with a population of 500,000-1,000,000:

1. City of San Francisco
2. East Bay cities, stretching 25 miles from Richmond to Hayward, with Oakland as the major city in the group
3. Peninsula cities, covering 45 miles from the southern limits of San Francisco to San Jose.

Minor concentrations, with a population of less than 200,000:

1. Marin county communities near the Bay, Sausalito to Novato
2. Contra Costa County communities east of the Berkeley-Oakland Hills, Orinda to Concord.

Most trips to and from the major employment and business centers originate in the locations listed above, and these are the areas served by mass transit today.

Mass Transit Systems

The San Francisco Bay Area also shares with other metropolitan centers the postwar experience of shrinkage of its mass transit system. Transit riding has decreased substantially, and so has the service available. Routes have been discontinued, service on surviving routes has been cut, and fares have increased. On several interurban operations that serve rapidly growing communities, the passenger downtrend has been halted and increases have occurred. These increases, however, are not nearly proportionate to population growth. While the absolute passenger volume may increase, the relative share of mass transit in supplying the total transportation demand continues to decline, and that of the private automobile continues to rise. The wide acceptance of the five-day week and the eight-hour day has led to extremely sharp peak hour concentrations of transportation demand, and to very low riding volumes during off-peak hours on weekdays and during weekends. In fact, the term 'mass' transit seems appropriate at the present time mainly for peak hours, since a fully loaded transit vehicle during the off-peak period is the exception rather than the rule, and more persons are being transported in private automobiles during those hours than by transit vehicles. The sharp riding peaks and the low density of suburban population have created a situation in the Bay Area where mass transit, which thrives most where transportation demand is concentrated in space and dispersed in time, faces the exactly opposite condition: a demand concentrated in time but dispersed in space.

Two types of systems exist in the Bay Area: inter- and intraurban. Interurban lines serve the commuter, take him to the downtown areas of San Francisco and Oakland with only incidental local service in those cities, and cover considerable distances with stops beyond the collecting area spaced at long intervals. Intra-urban systems serve primarily the needs of local traffic, usually taking patrons from residences to nearest major business centers, with frequent stops and low route mileages.

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Fig. 2
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Interurban Systems:
Southern Pacific Commuter Operations

The oldest among the interurban systems now operating in the Bay Area is the commuter service provided by the Southern Pacific Railroad over 47 miles of main line track between San Jose and San Francisco (Fig. 2). Interestingly enough, it is also the fastest. Steam and diesel-powered trains take commuters from the primarily residential communities on the Peninsula to the Third and Townsend Street Depot in San Francisco. More than any other Bay Area system, the "SP" Peninsula service includes characteristics of a rapid transit operation: trains run on a railroad right-of-way that is grade-separated for most of its length within San Francisco; nearly half of the 83 grade crossings from San Francisco to San Jose are protected by automatic gates while the remainder are protected by automatic warning signals, manually operated gates or flagmen. Schedule speeds during peak hours are generally above 40 mph and reach 50 mph on express runs; these speeds would not be exceeded greatly even by the regional rapid transit system proposed for the future. The coaches used in this service are largely of pre-World War I vintage but in good condition; recently new air-conditioned double-deck gallery cars seating 145 passengers each have been added to the fleet (Fig. 3). Peak hour trains of ten to thirteen cars seat up to 1,450 passengers, and approximately 11,000 persons or more than 60% of the daily one-way passenger volume, are carried in the peak direction during a weekday peak hour.

At all but two of the 23 stations on the peninsula, free commuter parking lots are provided, totaling about 4,350 car spaces. This compares with approximately 16,000 passengers in each direction using the service on a weekday. All inbound trains terminate at the San Francisco Depot; there are no other stops near the downtown area and no transfer tickets to local transit lines are provided. Commuters are thus delivered to a point seven blocks distant from Market Street, the main artery of San Francisco, although most of them wish to go to Market Street and the financial and shopping centers north of it. These commuters then become a load upon the city streets, either as pedestrians or as local transit riders. In either case, they spend ten or more minutes after leaving the train in reaching their San Francisco destinations.

This feature of inconvenient passenger delivery in San Francisco is common in some measure to all interurban systems serving the City. No distribution through the downtown district is provided, and artificial passenger concentrations are created at the terminals.

While the outer terminus of an interurban line is located often in thinly populated territory at the border of the metropolitan region, San Jose, the southern terminus of the "SP" comuter service, is a rapidly growing city of more than 110,000 people. It does, however, exert a substantial influence on Southern Pacific commuter traffic, which consists primarily of moving Peninsula residents to and from San Francisco.

During the evening peak, express trains leave San Francisco on 3-minute headways in such a manner that trains to the southernmost points depart first. Therefore, most passengers reach their destination station at about the same time, regardless of distance from the city. Fast service and rapid population growth have combined to produce a result unusual in postwar mass transit: Southern Pacific peninsula service is showing a steady increase in passengers.

Fig. 3
Interior of new gallery commuter cars seating 145 passengers, now in use on Southern Pacific Peninsula trains.

Transbay Service — General

The heaviest interurban traffic in the Bay Area exists between San Francisco and the East Bay, across some five miles of open water. Prior to the opening of the San Francisco-Oakland Bay Bridge, the primary means of transbay travel was the train-ferry service. An extensive network of electric train lines collected passengers in the residential and business sections of Oakland, Berkeley, Alameda and other Eastbay cities for delivery to ferry slips. Passengers transferred to the ferries for a 20-minute ride to San Francisco and a walk or local transit ride to their destinations. Far more people per day used this service than are now using mass transit across the Bridge.

Bay Bridge design has provided for mass transit like few other traffic facilities in the nation. While the upper deck is reserved for private automobiles, the lower deck carries a three-lane roadway intended for the exclusive use of buses and trucks, and two tracks for interurban trains. A large, modern terminal in downtown San Francisco, erected upon completion of the Bridge, serves interurban trains and offers transfer facilities to local transit.

Soon after January 1939, however, when mass transit facilities on the Bridge were put into full operation, a series of events began that has reduced mass transit volumes far below the capacity of the tracks and of the bus-truck lanes. Rapid increase in automobile traffic brought quick automobile bridge toll reductions that produced further traffic volume increases, interrupted only by the war years. Mass transit passenger volumes declined, again with the exception of the war years, so that only five of the original twelve train lines survive; the others have been converted to bus lines. While the tracks are not used to capacity, the load on the bus-truck lanes has increased by conversion of train lines to bus service, by a substantial rise in truck traffic, and by the admission of automobiles to the lower deck during peak hours to relieve the congested upper deck. There, capacity volumes that had not been expected for several decades have been attained regularly during weekday peaks since the end of World War II. A second Bay crossing has been discussed and planned for the last ten years but construction has not

begun. Meanwhile, the three lanes on the lower deck of the Bay Bridge are operated during peak hours with a reversible one-way center lane, soon to be controlled by overhead signals that are already installed. This makes two full lanes available in the heavy direction. Buses and trucks, however, are not allowed to pass or to use the center lane during peak hours so that they are restricted to the curb lanes where speed is governed by the slowest vehicle, often a heavy tractor-trailer combination climbing one of the grades on the bridge.

An application is pending now before the California Public Utilities Commission to convert the remaining five train lines to bus service. Under this proposal, the two curb lanes of the lower Bay Bridge deck would carry the entire transbay mass transit load while neither the bridge rails nor the interurban train terminal in San Francisco would be used at all. The Commission is now considering this application, together with alternate proposals that include a plan to pave the rail portion of the lower deck for use by buses, and to convert the terminal to a union bus terminal.

Courtesy, Key System Transit Lines

Fig. 4
Key System transbay train on right-of-way in Trestle Glen residential section of Oakland. Articulated cars seat 132 passengers.

Key System Transbay Service

The largest interurban carrier in the Bay Area at present is the Key System, controlled by National City Lines. It also provides intraurban service in the East bay as described later. (Fig. 4)

Key System presently operates the five transbay train lines from Oakland, Berkeley and Piedmont, and nine transbay bus lines from Richmond, Hayward, Alameda and other Eastbay cities. Route mileages vary from 10 to 12 miles for trains and from 13 to 25 miles for buses. Passengers starting from points that are not close to any one of the fourteen transbay lines can use Key System's Eastbay local buses and then transfer with no additional cost over the standard transbay fares.

Transbay trains operate in the Eastbay essentially as streetcars. They travel at grade on major city streets where they are slowed by conflicts with vehicular traffic. Most stops are spaced 0.2 to 0.4 miles apart, somewhat further than in typical streetcar operation.

Trains travel on a separate right-of-way on the Bay Bridge approach, then cross the Bay on the lower deck of the Bridge. Transbay buses use city streets in their collecting areas and proceed via major thoroughfares or completed portions of the Eastshore Freeway to the lower deck of the Bay Bridge. The bus trip is completed via San Francisco city streets.

All lines terminate at the Bay Bridge Terminal at First and Mission Streets in San Francisco and do not stop elsewhere in the City. The terminal was intended for rail service. Key System buses, therefore, must use curb space on the city streets surrounding the terminal for loading and unloading. The terminal is located one block from Market Street and close to the financial center. Easy transfer to San Francisco streetcars is provided for transbay passengers destined to the more distant shopping and Civic Center areas; no transfer tickets are issued, however, and a new fare must be paid.

Key System trains consist of one or more units seating 132 passengers each. Bay Bridge design incorporates automatic control devices allowing the trains to operate at 60-second headways with a capacity of 40,000 to 50,000 passengers per hour. Actual peak hour headway on the bridge today is about four minutes, and approximately 3,800 passengers are carried on the trains during the peak hour. During World War II, train passenger volumes came much closer to the capacity of the tracks. The postwar years, however, brought not only a phenomenal increase in automobile traffic but also a phenomenal drop in Key train patronage, from 22,200,000 passengers in 1946 to less than six million passengers in 1955. Key transbay bus patronage per year has dropped from 9,400,000 in 1946 to 4,100,000 in 1955.

Key System trains and buses together transported slightly less than ten million passengers across the bridge in 1955, contrasted with 31,600,000 in 1946.

Length of routes, low overall speeds—18 mph for trains, 21 mph for buses—and short, sharp weekday peaks combine to make it difficult for a transit vehicle to complete more than one transbay trip during the peak periods. Since off-peak volumes are low, many units make only one complete roundtrip per day, necessitating storage facilities on both ends of the line. All major Bay Area systems face this difficulty.

Pacific Greyhound Suburban Operations

While Southern Pacific operates the fastest interurban service in the Bay Region and Key System the biggest in terms of passengers per day, Pacific Greyhound Lines, the third major interurban carrier, can claim another superlative: its system is the most extensive. While the other carriers each serve San Francisco from one direction only, Greyhound suburban buses use all three available gateways. Bus lines from Marin County on the north and from Contra Costa County on the east are, like Key System transbay lines, successors to the pre-bridge train-ferry service, while Greyhound routes on the Peninsula are partly parallel to and competitive with Southern Pacific commuter trains. Several Greyhound routes have experienced passenger gains in recent years.

Two groups of Greyhound bus lines serve rapidly growing Marin County. Six bus routes originate in the residential towns of Novato, San Rafael, Fairfax and Mill Valley. After collecting passengers in various other communities, all buses proceed on U. S. 101 south across the Golden Gate Bridge into San Francisco, then via bridge ramps and major city streets to the Seventh Street Greyhound terminal near Market

Street. Marin County has no local transit system, and Greyhound also provides local service along its routes.

Another group of thirteen lines starts from the towns listed above and also from Marin City and Belvedere. This group serves mainly commuters destined to San Francisco's financial district. Buses operate during peak hours only and terminate at the foot of Market Street in front of the Ferry Building that served as interurban terminal fifteen years ago. (Fig. 5) Speed on most Marin routes is 18 to 24 miles per hour and routes are from 12 to 30 miles long. About 5,500 passengers in each direction are using the interurban service on weekdays; 50% of these travel during the peak hour.

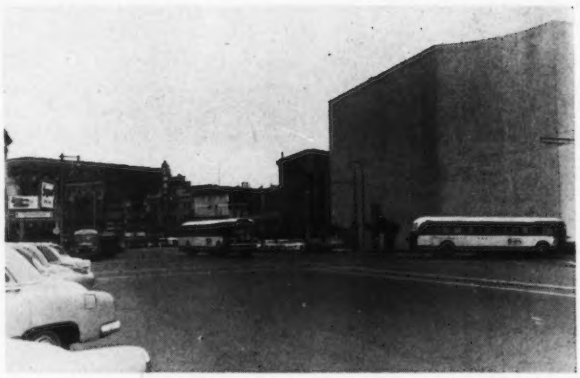
Greyhound suburban lines in the Eastbay serve primarily the rapidly developing central part of Contra Costa County. Four routes begin in Concord and in industrial towns north of that city. Passengers are collected in Walnut Creek, Pleasant Hill, Lafayette and other residential communities. The routes continue via completed portions of freeway to the four-lane Broadway Tunnel, the only connection of central Contra Costa County to the Eastbay and San Francisco. Beyond the tunnel, buses use city streets to reach either the Greyhound terminal in downtown Oakland or the lower deck of the Bay Bridge. The heavier peak movement is to San Francisco, where the trip is completed on city streets to

Courtesy, Pacific Greyhound Lines

Fig. 5
Greyhound terminal for Marin County commuters on the Embarcadero at San Francisco's Ferry Building.

the Seventh Street terminal. Commuters taking this trip must cross both a range of hills and the Bay. The distance from the San Francisco terminal to Concord is 30 miles and is covered at schedule speeds of about 21 miles per hour. The number of one-way passengers carried to San Francisco on a weekday approximates 2,000, with about 47% of that number riding during the peak hour.

Greyhound also operates nine lines on the Peninsula that supplement Southern Pacific rail service to some extent. Greyhound offers more service during off-peak periods and stops more frequently on the Peninsula and in the outer portions of San Francisco. Three of the nine Peninsula routes serve districts located remote from the rail stations. The others originate in San Jose, Palo Alto, Redwood City and San Mateo; all but one of these use the Bayshore Freeway after completing their passenger pickups to reach the Seventh Street terminal in San Francisco. Most of the major commuter points on the Peninsula are within 35 miles of the terminal. Schedule speeds are generally between 18 and 28 miles per hour. About 6,000 persons use the service on a



Courtesy, Pacific Greyhound Lines

Fig. 6
Greyhound buses destined for the Peninsula from San Francisco terminal must cross Market Street (background) twice to reach freeway, due to one way street plan.

weekday to go to San Francisco, but only about 30% of these arrive during the peak hour.

Greyhound suburban equipment consists primarily of diesel buses, largely of pre-World War II vintage. Most routes are operated in part over freeways, and some service difficulties have grown out of the fact that until recently, no bus turnouts have been provided on Bay Area freeways. Newly completed portions of freeway, however, include bus stops for use by Greyhound. In San Francisco, buses stop on city streets in the outer districts but, with minor exceptions, not in the center of the city. No free transfer to local transit is provided (Fig. 6).

Intraurban Systems — San Francisco Municipal Railway

San Francisco residents are served by the city-owned Municipal Railway, the successor to the many different transit lines that once existed in this city.

The 60 routes of the "Muni" provide a dense coverage of the city, and there are few residences more than ¼ mile from transit service. The system includes 7 streetcar lines, 15 trolley coach and 35 bus routes, operated with both gasoline and diesel equipment, as well as 3 cable car lines (Fig. 7). The latter cause many operating problems that leave management somewhat short of happy with the ancient and

Courtesy, Charles E. Hunt

Fig. 7
Cable car on California Street, close to Chinatown and the Mark Hopkins Hotel, site of the 26th ITE Annual Meeting.

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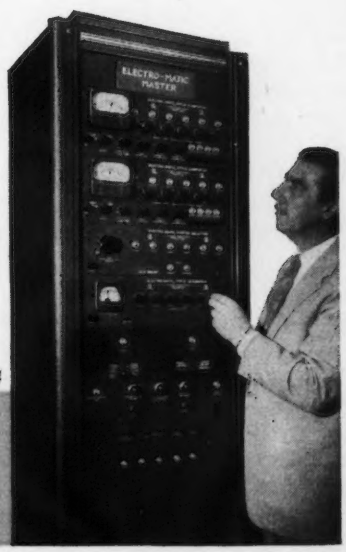

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Summary of Major Bay Area Mass Transit Systems

System (1)	Type (2)	Area Served (3)	Equipment Used (4)	Routing (5)	Approximate 1956 Weekday Passenger Volume* (6)	Typical Peak Hour Schedule Speed m.p.h. (7)	System Owned by (8)
Southern Pacific Commuter Service	Interurban	Peninsula	Steam & Diesel Trains	RR Right-of-way, partly grade separated	32,000	45	Southern Pacific Railroad
Key System Transbay Service	Interurban	Eastbay	Electric Trains	Bay Bridge Tracks, Streets Right-of-way	20,000	18	National City Lines (Controlling)
			Gasoline Buses	Bay Bridge, Freeway, Streets	14,000	21	
Greyhound - Marin Service	Interurban	Marin County	Diesel Buses	Golden Gate Bridge, Freeway, Streets	11,000	20	Pacific Greyhound Lines
Peninsula Service	Interurban	Peninsula Central	Diesel Buses	Freeway, Streets	12,000	23	
Contra Costa Service	Interurban	Contra Costa County	Diesel Buses	Bay Bridge, Freeways, Streets	4,000	21	
San Francisco Municipal Railway	Intraurban	San Francisco	Streetcars, Cable Cars, Trolley Coaches, Gasoline & Diesel Buses	Streets, Right-of-way (tunnels), Freeway	418,000	10	City of San Francisco
Key System Eastbay Service	Intraurban	Eastbay Cities	Diesel & Gasoline Buses	Streets	137,000	12	National City Lines (Controlling)

*Figures for interurban systems include only passengers with either origin or destination in San Francisco.

colorful vehicles. In the view of a substantial segment of the citizenry, however, cable cars are absolutely essential to the character of the city and must not be abolished. The once extensive network of cable car lines has now been trimmed to a few, well-patronized routes.

An important feature of Municipal Railway operations is the 2.3-mile Twin Peaks streetcar tunnel. It is used by three of the streetcar lines and is part of a proposed rapid transit system for San Francisco. Streetcar lines use 40 one-man PCC cars and 124 older cars requiring two-man operation. Among the techniques used by the Municipal Railway to cope with downtown congestion, sharp peaks and low off-peak riding, are express buses, including non-stop operation on Bayshore freeway, and a five-cent midday "Shopper's Shuttle" service in the central and Mission business districts. The city-wide fare is 15 cents. Altogether, the 862 pieces of equipment of the Municipal Railway hauled some 145,000,000 passengers last year, more than all other Bay Region transit systems combined. Passenger volume on a weekday, with schools in session, is about 418,000.

In accordance with the trafficways plan of the City Planning Commission, several major streets in San Francisco have become primarily transit streets. Market Street, the site of four-track streetcar operation until a few years ago, is used heavily by streetcars and buses. Sutter and Geary Streets, flanked on both sides by efficient one-way streets with coordinated signals, carry considerable bus and streetcar traffic. While automobiles are not banned from these transit streets, motorists are less attracted to them than to parallel one-way thoroughfares free of mass transit vehicles.

Key System Eastbay Service

Residents of Eastbay Cities, from Richmond in the north to Hayward in the south, are served by Key System on both transbay trips to San Francisco and local trips within the Eastbay. Key System operates 58 local bus routes, using primarily postwar diesel equipment. While San Francisco is a compact city covering a 7-mile square, the East Bay includes more than a dozen different cities and communities. The area served by Key System covers more than 25 miles in the north-south direction, and 14 routes exceed 10 miles in length. Most of the major routes lead to the central business district of Oakland or pass through it. Other routes are cross-town feeders for the major north-south lines; some serve the business districts of Berkeley, Richmond and Hayward, and the major military installations on the Bay. Some routes include spectacularly scenic climbs in the Berkeley-Oakland Hills. The basic fare is 20c; zone fares are in effect for trips to the Richmond-San Pablo and San Leandro-Hayward areas. Key System Eastbay service has also suffered severe postwar losses in riding.

Other Systems

Bay Area residents are also served by local bus lines in San Jose (7,860,000 passengers in 1955), Palo Alto, San Mateo-Burlingame, and South San Francisco. Southern Alameda County, where five unincorporated communities have recently combined to form huge but so far sparsely populated 100-square miles city of Fremont, is served by Peerless Stages; this line connects Oakland with San Jose and Palo Alto and also serves points outside the Bay Region. In addition, there are special purpose bus systems: limousines operate from downtown San Francisco and Oakland to the airports, and the armed services maintain a network of bus routes to transport service personnel between the numerous Bay Region military installations. Jitney service still exists along Mission Street in San Francisco.

An interesting sidelight on mass transit in the Bay Area is provided in the North Bay; there, one of the last surviving ferry lines operates between Richmond and San Rafael. The ferry primarily serves automobiles; pedestrians have no bus within miles of either terminal of the ferry to continue their trip. Ferry service ends on September 1, 1956, upon opening of the new Richmond-San Rafael Bridge, a double-decked modern structure connecting important parts of the metropolitan area and, after the Bay Bridge, the second largest high level bridge in the world. Yet, at this writing, only a few weeks prior to the opening, no definite plans exist to provide any regular public transportation service across the Richmond-San Rafael Bridge.

Conclusion

This discussion has covered in general terms the mass transportation systems presently operating in the Bay Area. Routes, equipment, and passenger volumes have been described to convey an overall picture of the role mass transit plays in the problem of concern to the traffic engineer, that of moving people and vehicles. The summary table in this article shows a few salient facts about each of the major

(Concluded on page 563)

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Extrapolation of Traffic Volumes into the Future

By Alice Van Boven, Junior Civil Engineer

California Division of Highways, San Bernardino, California

Highways are ordinarily designed to accommodate expected traffic volumes twenty years after completion. This makes it necessary to extrapolate present trends a good many years into the future. At locations where no diverted, generated or induced traffic is expected to alter the pattern, and where volume counts are available for a number of years in the past, the method involves a continuation of present trends.

A graphical presentation is always helpful and is a logical first approach to the problem. Should the graph show an approximate straight line for a number of years previous to the present, the method of arithmetical progression is a sound one. However a curve is very often depicted by the graph, and a method combining curve fitting with extrapolation is necessary. Geometric progression may be used in some cases, but this utilizes an exponential curve, and is likely to produce volumes fantastically high in twenty years time. A better method for many cases fits the curve to a section of parabola, and has been called the Incremental Increase method.

Formulas for the three methods will be developed, using the notation:

T_f = volume of traffic to be predicted f years hence.

T_n = present traffic volume.

T_o = traffic volume n years ago.

The standard formula for arithmetical progression then

(1) becomes $T_f = T_n + \frac{f}{n}(T_n - T_o)$

The easiest way to use geometric progression is to find a suitable traffic count as many years in the past as a prediction for the future is required. In that case the geometric ratio is a direct one, and $f = n$.

(2) Then, $T_f = T_n \times \frac{T_n}{T_o}$ or $T_f = \frac{T_n^2}{T_o}$

Should it be required to extrapolate into the future a greater number of years than the number for which traffic counts in the past are available and usable, then the standard formula for compound interest can be adapted to fit the problem. This equation is ordinarily seen in the form

$L = a\,r^{n-1}$

where a is the first term, L the last and "n" the total number of terms including the first and last. In our notation "f" is equal to one less than this total number of terms, so the

(3) formula become $T_f = T_n r^f$ Similarly, $T_n = T_o r^n$

This "r" may be read from a compound interest table and the problem solved therefrom, or logarithms may be used. Converting equation #3 to the logarithmic form,

(4) $\text{Log } T_f = \text{Log } T_n + f \text{ Log } r.$

But $r^n = \frac{T_n}{T_o}$ so $\text{Log } r = \frac{\text{Log } T_n - \text{Log } T_o}{n}$

Substituting this value for Log r in equation #4

$$\text{Log } T_f = \text{Log } T_n + \frac{f}{n}(\text{Log } T_n - \text{Log } T_o) \qquad \textbf{(5)}$$

Equation #5 is the formula to be used for geometric progression when solving by the use of logarithms.

A possible modification of extrapolating by the use of geometric progression is instead of yearly intervals to use the traffic counts for every second or every third year, reducing the number of terms, but the method is the same.

The formula for Incremental Increase makes use of first and second derivatives, as is the case for any second degree equation. The first derivative is the average increment in traffic volumes; the second derivative is the average difference of the differences. The first derivative alone will add to present traffic the same amount as in an arithmetical progression; it is the second derivative that adds an increment which produces a curved or second degree relationship.

The first derivative, $d_1 = \frac{T_n - T_o}{n}$ **(6a)**

The second derivative,

$$d_2 = \frac{T_n - T_{n-1} - (T_1 - T_o)}{n-1} = \frac{T_n + T_o - T_{n-1} - T_1}{n-1} \qquad \textbf{(6b)}$$

Adding increments year by year. (Refer to sample problems)

$$T_{n+1} = T_n + d_1 + d_2 \frac{(n+1)}{2}$$

$$T_{n+2} = T_n + \left[d_1 + d_2 \frac{(n+1)}{2}\right] + \left[d_1 + d_2 \frac{(n+1)}{2} + 1\right]$$

$$T_{n+3} = T_n + \left[d_1 + d_2 \frac{(n+1)}{2}\right] + \left[d_1 + d_2 \frac{(n+1)}{2} + 1\right] + \left[d_1 + d_2 \frac{(n+1)}{2} + 2\right]$$

$$T_f = T_n + \left[d_1 + d_2 \frac{(n+1)}{2}\right] + \left[d_1 + d_2 \frac{(n+1)}{2} + 1\right] + \cdots + \left[d_1 + d_2 \frac{(n+1)}{2} + f - 1\right]$$

Collecting terms and summating the series:

$$T_f = T_n + f\,d_1 + d_2\left[f\frac{(n+1)}{2} + f\frac{(f-1)}{2}\right]$$

$$T_f = T_n + f\,d_1 + \frac{f}{2}\,d_2\,(n+f)$$

Substituting the values for d_1 and d_2 from equations #6:

$$T_f = T_n + \frac{f}{n}(T_n - T_o) + \frac{f(n+f)}{2(n-1)}(T_n + T_o - T_{n-1} - T_1) \qquad \textbf{(7)}$$

Equation #7 can be solved directly from the traffic counts, and is the formula to be used for Incremental Increase.

From observation of the two sample problems appended, it is obvious that the Incremental Increase method is the only one of the three described which produces different results for increasing or decreasing increments. Accordingly, great care must be exercised in choosing which years volume counts will produce the most realistic results. To this end it is always advisable to start with a graphical presentation, and then to choose for insertion in the formula years with traffic volumes which are in line with the general trend. Results decidedly spurious can result from basing the computation on irregular years. In the case of consistently decreasing increments it would be unwise to carry the prediction too far ahead, but to stop before the point of diminishing returns.

SAMPLE PROBLEM #1: Parabola curved upward; increment increasing.

	d_1	d_2
T_o = 800		
	100	
T_1 = 900		10
	110	
T_2 = 1010		10
	120	
T_3 = 1130		10
	130	
T_4 = 1260*		10
	140	
T_n = 1400		
Summation	600	40
Average increment	120	10

Extrapolate 15 years ahead, so f = 15.

By arithmetical progression, apply equation # 1

$$T_f = 1400 + \frac{15}{5} \times (1400 - 800)$$

T_f = 3200 which represents a gain of 2.3%.

By geometric progression, apply equation #5.

$$\text{Log } T_f = \log\ 1400 + \frac{15}{5}(\log 1400 - \log 800)$$

Tf = 7500 which represents a gain of 5%.

By incremental increase, applying equation #7:

$$T_f = 1400 + \frac{15}{5} \times (1400\text{-}800) + \frac{15 \times 20}{2 \times 4}(1400 + 800 - 1260 - 900)$$

$$T_f = 1400 + 1800 - 1500$$

T_f = 4700 which represents a gain of 3.7%.

SAME PROBLEM #2: parabola curved downward; increment decreasing.

	d_1	d_2
T_o = 800		
	140	
T_1 = 940		10
	130	
T_2 = 1070		10
	120	
T_3 = 1190		10
	110	
T_4 = 1300		10
	100	
T_n = 1400		
Summation	600	40
Average increment	120	10

Extrapolate 15 years ahead, so f = 15.

By arithmetical and geometric progression the results are identical with those of problem #1.

By incremental increase, applying equation #7:

$$T_f = 1400 + \frac{15}{5} \times (1400\text{-}800) + \frac{15 \times 20}{2 \times 4}(1400 + 800 - 1300 - 940)$$

$$T_f = 1400 + 1800 + 1500$$

T_f = 1700 which represents a gain of 1.2%.

In the case of problem #2 diminishing returns start after ten years, at which time the maximum value of 1850 is obtained.

The formulas in this article show a concise and simple way to compute future traffic trends at locations where volume counts have been made. They are applicable and accurate where the graph shows a trend consistent with the formula, provided of course that generated, diverted or induced traffic is not to alter the picture.

MASS TRANSIT IN THE BAY AREA

(Continued from page 560)

systems. During the peak hour, which is the critical period governing traffic planning considerations, mass transit handles approximately the following percentages of the total urban peak hour trips:

San Francisco—	
Peninsula Gateway	56%
Bay Bridge Gateway	49%
Golden Gate Bridge Gateway	43%
Intra-urban	51%
Eastbay Intra-urban—	
No figure readily available; percentage will be lower than for San Francisco Intra-urban.	

Government and administration in the Bay Region are, as in other metropolitan areas, split into many different city, county and district jurisdictions. Mass transit is similarly heterogeneous, consisting of four major and several minor systems. All systems, however, have experienced in some measure the common postwar cycle of the twin causes, operating cost increase and passenger loss, producing the twin effects of fare increases and service cuts, followed by more cost increases and passenger losses. Phenomenal population increases have slowed, stopped, and even reversed phases of this cycle in some instances, but it still dominates the transit situation. While mass transportation is experiencing a spiraling downward trend, individual transportation by automobile is climbing an ascending spiral of vehicle mile and gas tax revenue increases, producing better highways and more freeways, followed by further increases in vehicle miles and tax revenue. Private vehicles offer ever more competition to surface transit vehicles for precious peak hour street space.

In recent years, there has been a growing feeling in the Bay Region that its splendid bridges and freeways are not the sole answer to the transportation need but must be supplemented by modern mass transit, and that mass rapid transit is not a local but a regional problem. The nine Bay Area Counties have formed the San Francisco Bay Area Rapid Transit Commission, which hired a prominent firm of New York engineers to conduct an exhaustive study of the possibilities of providing rapid transit for the Bay Region. The study has been completed and an impressive report has been published, which should be the subject of a future article in TRAFFIC ENGINEERING. Briefly, the report proposes the construction of a publicly owned, 123-mile rapid transit network connecting San Francisco with other Bay Area Cities via all three gateways by means of high speed electric trains. Future extensions would increase the total system mileage.

This challenging plan has evoked considerable discussion. The Rapid Transit Commission is currently drafting proposals for legislation to put the plan into effect. It will be considered by the California Legislature and, in the event of favorable action, by the voters, presumably some time in 1957. The outcome of these votes will, of course, be vital for the future of Bay Region transit.

Whatever the outcome of the votes, ITE visitors to the Bay Area will do well to take a good look at existing mass transit facilities; there has been continuous change in recent years, and it is likely that change will continue. The visitor a few years hence will not find the same situation as today, for the years ahead are a period of decision for mass transit in the San Francisco Bay Area.

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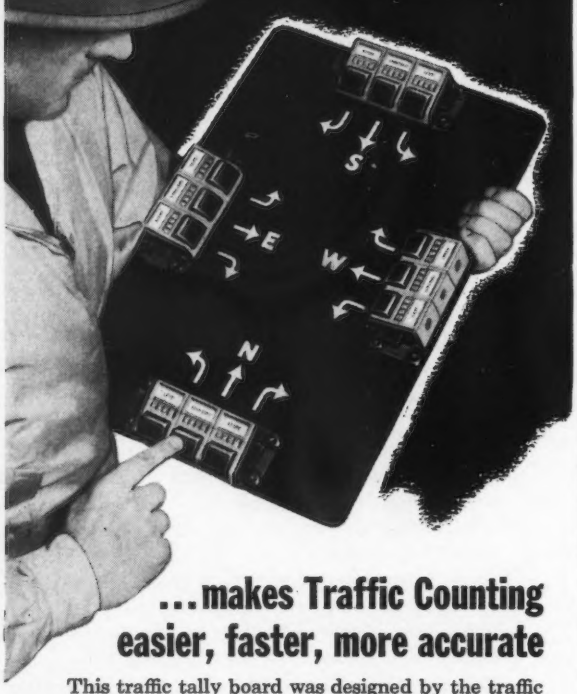

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Yearbook Changes

BARTELS, William J. (Junior)
Principal Traffic Engineer, Bureau of Traffic Safety. SEND MAIL: 15 Southard Street, Trenton 9, New Jersey.

CLEARY, Edward F. (Junior)
Assistant Director, Dept. of Traffic Engineering, 421 W. Conway Street, Baltimore 2, Maryland.

CRAWFORD, Glenn A. (Associate)
City and Street Superintendent. SEND MAIL: 540 Meadow Lane, Pomona, California.

CURRY, William R. (Associate)
District Traffic Engineer, Department of Highways, 450 Spokane Street, Seattle, Washington.

DEETZ, Russell S. (Member)
Traffic Engineer, Ohio Turnpike Commission, 8620 Lindberg Boulevard, Berea, Ohio.

FRAVEL, H. Dean (Associate)
Task Force on Water Resources & Power Comm. Organization of the Exec. Branch of the Government, Washington, D. C. SEND MAIL: 1804 Nealon Drive, Falls Church, Virginia.

FRIEDMAN, Edmund (Member)
Vice-President, Maurice H. Connell & Associates, Inc., 315 N. W. 27th Avenue, Miami 35, Florida.

GARDNER, John W., Jr. (Junior)
Junior Civil Engineer in Traffic Engineering, Department of Public Works, Division of Highways, District X, Stockton. SEND MAIL: 69-A Franklin, China Lake, California.

KANSMAN, Sven (Associate)
Wayne County Road Commission. SEND MAIL: 15240 Fordham, Detroit 5, Michigan.

KOCH, Charles W. (Junior)
Junior Civil Engineer, City & County of San Francisco, Dept. of Public Works. SEND MAIL: 350 Geary Street, San Francisco 2, California.

KRUEPER, Lt. (jg) Harry J., Jr. (Junior)
Construction Equipment Officer, Civil Engineer Corps., U. S. Navy, Subic Bay, Philippine Islands. SEND MAIL: 1350 California Street, Oxnard, California.

MATTHEWS, Walter W. (Member)
Managing Director, Philadelphia Safety Council, 121 S. Broad Street, Philadelphia 7, Pennsylvania.

MERRIAM, Lucius A. (Member)
Chief Engineer, Western Concrete Products, Inc. SEND MAIL: 1418 Avenue "D," Bismarck, North Dakota.

OFFENBECHER, E. R. (Junior)
Forest Lawn Memorial Park, Glendale. SEND MAIL: 9645 Saluda, Tujunga, California.

PRATHER, J. Gordon (Associate)
Traffic Engineering Associate, Department of Traffic, Room 1000, City Hall, Los Angeles 12, California.

REEDER, Earl J. (Member)
Partner, Rader and Associates, 111 N. E. 2nd Avenue, Miami 32, Florida.

ROBBINS, Donald O. (Junior)
Assistant Traffic Engineer, City of San Diego. SEND MAIL: 5428 Forbes Avenue, San Diego 15, California.

ROSA, Irwin H. (Junior)
Associate Highway Engineer, District V, California Division of Highways, 50 Higuera Street, San Luis Obispo, California.

RUDUDEN, James B. (Junior)
Assistant Traffic Director, Dept. of Traffic Engineering. SEND MAIL: 2002 Rollingwood Road, Baltimore 28, Maryland.

SUMNERS, James H. (Associate)
Office Traffic Engineer, Mississippi Highway Department. SEND MAIL: 228 Hartfield, Jackson, Mississippi.

VICK, Alfred, III (Associate)
Associate Traffic & Planning Engineer, Virginia Dept. of Highways. SEND MAIL: 4801 Park Avenue, Richmond, Virginia.

Will A Secretary Go To Heaven?

(The following, which has been lifted from the IACP magazine, is reprinted exclusively for those who have served or will serve at one time or another as secretary to some organization.)

If a Secretary writes a letter, it is too long. If he sends a postal, it's too short. If he doesn't send a notice, he is lazy. If he attends a committee meeting, he's butting in. If he stays away, he is a shirker. If he duns the members for dues, he is insulting. If he fails to collect dues, he is slipping. If he asks for advice, he is incompetent. If he does not, he is bullheaded. If he writes his reports complete, they are too long. If he condenses them, they are incomplete. If he talks on a subject, he is trying to run things. If he remains quiet, he has lost interest in the meetings. Ashes to ashes, dust to dust; if the others won't do it, the Secretary must.

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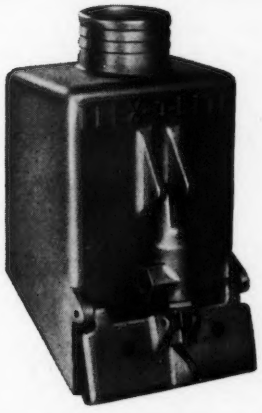

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Traffic News

New Standards for Interstate System Approved

The Commissioner of Public Roads, acting for the Secretary of Commerce, has approved the new geometric design standards for the National System of Interstate and Defense Highways. These standards were adopted by the states at a meeting of the Committee on Administration of the American Association of State Highway Officials held in Chicago in July.

The newly approved standards are essentially the same as those used in the study to determine the needs on the Interstate System, upon which the Federal-Aid Highway Act of 1956 is based. The high level of design required by these standards emphasizes the importance which highway officials attach to the Interstate System.

The new standards are reprinted here in their entirety.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS

COMMITTEE ON PLANNING AND DESIGN POLICIES

Geometric Design Standards for the National System of Interstate and Defense Highways* Adopted July 12, 1956

General

The National System of Interstate and Defense Highways is the most important in the United States. It carries more traffic per mile than any other comparable national system and includes the roads of greatest significance to the economic welfare and defense of the Nation. The highways of this system must be designed in keeping with their importance as the backbone of the Nation's highway systems. To this end they must be designed with control of access to insure their safety, permanence and utility and with flexibility to provide for possible future expansion. Two-lane highways should be designed so that passing of slower moving vehicles can be accomplished with ease and safety at practically all times. Divided highways should be designed as two separate one-way roads to take advantage of terrain and other conditions for safe and relaxed driving, economy, and pleasing appearance. All known features of safety and utility should be incorporated in each design to result in a National System of Interstate and Defense Highways which will be a credit to the Nation.

These objectives can be realized by conscious attention in design to their attainment. All Interstate highways shall meet the following minimum standards. Higher values which represent desirable minimum values, a device used in previous Interstate standards, are not shown because it is expected that designs will generally be made to values as high as are commensurate with conditions, and values near the minimums herein will be used in design only where the use of higher values will result in excessive cost. In determination of all geometric features, including right of way, a generous factor of safety should be employed and unquestioned adequacy should be the criterion. All design features required to accommodate the traffic of the year 1975 shall be provided in the initial design; however, where justifiable, the construction may be accomplished in stages.

The Association Policy on Geometric Design of Rural Highways, the Policy on Arterial Highways in Urban Areas, when adopted, and the Standard Specifications for Highway Bridges shall be used as design guides where they do not conflict with these Standards.

Traffic Basis

Interstate highways shall be designed to serve safely and efficiently the volumes of passenger vehicles, buses and trucks, including tractor-trailer and semi-trailer combinations and corresponding military equipment, estimated to be that which will exist in 1975, including attracted, generated, and development traffic on the basis that the entire system is completed.

The peak-hour traffic used as a basis for design shall be as high as the 30th highest hourly volume of the year 1975, hereafter referred to as the design hourly volume, "DHV(1975)." Unless otherwise specified, DHV is the total, two-direction volume of mixed traffic.

Control of Access

On all sections of the Interstate System, access shall be controlled by acquiring access rights outright prior to construction or by construction of frontage roads, or both. Control of access is required for all sections of the Interstate System. Under all of the following conditions, intersections at grade may be permitted in sparsely settled rural areas which are a sufficient distance from municipalities or other traffic-generating areas to be outside their influence, and where no appreciable hazard is created thereby.

(a) The Interstate highway is a two-lane highway having a DHV (1975) of less than 500.

(b) Each intersection at grade is with a public road or private driveway with little potential for traffic increase and on which the current ADT does not exceed 50 vehicles.

(c) Such intersections do not exceed two per side of the Interstate highway per mile.

(d) Sufficient additional corner right of way at each intersection at grade is acquired to insure that access connections on the crossroad are sufficiently removed to minimize interference with the Interstate highway.

(e) The right to eliminate, terminate, or reroute each such public road or private driveway is vested in the appropriate public authority at the time of initial construction.

Where a grade separation is called for under these standards and extraordinary conditions exist under which a grade separation would not be in the public interest, an intersection at grade may be permitted through agreement between the State highway department and the Secretary of Commerce.

Railroad Crossings

Railroad grade crossings shall be eliminated for all through traffic lanes.

Intersections

All at-grade intersections of public highways and private driveways shall be eliminated, or the connecting road terminated, rerouted, or intercepted by frontage roads, except as otherwise provided under Control of Access.

Design Speed

The design speed of all highways on the system shall be at least 70, 60, and 50 miles per hour for flat, rolling, and mountainous topography, respectively, and depending upon the nature of terrain and development. The design speed in urban areas should be at least 50 miles per hour.

*To supersede the Design Standards for the National System of Interstate Highways, adopted August 1, 1945.

Curvature, Superelevation, and Sight Distance

These elements and allied features, such as transition curves, should be correlated with the design speed in accordance with A Policy on Geometric Design of Rural Highways.

On two-lane highways, sections with sufficient sight distance for safe passing should be frequent enough and the total length of such sections be a sufficient percentage of the highway length to accommodate the DHV. Where it is not feasible to provide enough passing opportunities, a divided highway should be provided instead.

Gradients

For design speeds of 70, 60, and 50 miles per hour, gradients generally shall be not steeper than three, four, and five per cent, respectively. Gradients two per cent steeper may be provided in rugged terrain.

Width and Number of Lanes

Traffic lanes shall not be less than 12 feet wide.

Where the DHV (1975) exceeds 700 or exceeds a lower two-lane design capacity applicable for the conditions on a particular section, the highway shall be a divided highway. For lower volumes, the highway shall be a two-lane highway so designed and located on the right of way that an additional two-lane pavement can be added in the future to form a divided highway.

Efficiency and capacity of two-lane highways may be increased by providing added climbing lanes on upgrades where critical lengths of grade are exceeded or by providing more frequent and longer sections safe for passing.

Medians

Medians in rural areas in flat and rolling topography shall be at least 36 feet wide. Medians in urban and mountainous areas shall be at least 16 feet wide. Narrower medians may be provided in urban areas of high right-of-way cost, on long and costly bridges, and in rugged mountainous terrain, but no median shall be less than four feet wide.

Curbs or other devices may be used where necessary to prevent traffic from crossing the median.

Where continuous barrier curbs are used on narrow medians, such curbs shall be offset at least one foot from the edge of the through-traffic lane. Where vertical elements more than 12 inches high, other than abutments, piers, or walls, are located in a median, there shall be a lateral clearance of at least three and one-half feet from the edge of through traffic lane to the face of such element.

	Minimum Width in Feet	
Type of Highway	*Without Frontage Roads*	*With Frontage Roads*
2-lane	150	250
4-lane divided	150	250
6-lane divided	175	275
8-lane divided	200	300

Shoulders

Shoulders usable by all classes of vehicles in all weather shall be provided on the right of traffic. The usable width of shoulder shall be not less than 10 feet. In mountainous terrain involving high cost for additional width, the usable width of shoulder may be less but at least six feet. Usable width of shoulder is measured from edge of through-traffic lane to intersection of shoulder and fill or ditch slope except where such slope is steeper than 4:1 where it is measured to beginning of rounding.

Slopes

Side slopes should be 4:1 or flatter where feasible and not steeper than 2:1 except in rock excavation or other special conditions.

Right of Way

Fixed minimum widths of right of way are not given because wide widths are desirable, conditions may make narrow widths necessary, and right of way need not be of constant width. The following minimum widths are given as guides.

In rural areas right-of-way widths should be not less than the following, plus additional widths needed for heavy cuts and fills:

In urban areas right-of-way width shall be not less than that required for the necessary cross section elements, including median, pavements, shoulders, outer separations, ramps, frontage roads, slopes, walls, border areas, and other requisite appurtenances.

Culverts

All culverts shall be of sufficient length to accommodate the pavements, median, and shoulders.

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Bridges and Other Structures

The following standards apply to Interstate highway bridges, overpasses, and underpasses. Standards for crossroad overpasses and underpasses are to be those for the crossroad.

Bridges and overpasses, preferably of deck construction, should be located to fit the overall alinement and profile of the highway.

The clear height of structures shall be not less than 14 feet over the entire roadway width, including the usable width of shoulders. Allowance should be made for any contemplated resurfacing.

The width of all bridges, including grade separation structures, of a length of 150 feet or less between abutments or end supporting piers shall equal the full roadway width on the approaches, including the usable width of shoulders.

Barrier curbs on bridges longer than 150 feet between abutments or end supporting piers and curbs on approach highways if used shall be offset at least two feet. Offsets to face of parapet or rail shall be at least three and one-half feet measured from edge of through-traffic lane and apply on right and left.

The lateral clearance from the edge of through-traffic lanes to the face of walls or abutments and piers at underpasses shall be the usable shoulder width but not less than eight feet on the right and four and one-half feet on the left.

A safety walk shall be provided in tunnels and on long-span structures on which the full approach roadway width, including shoulders, is not continued.

Traffic Engineering Salaries

A recent survey was conducted by the city of Philadelphia to determine the annual salaries of traffic engineering employees in a number of large cities and counties. The following is a summary of this study.

Group I

Engineering college graduate with no experience ..... $4,863-$5,354

Group II

Engineering college graduate with one year of pertinent experience or of post-graduate training in traffic engineering $5,370-$6,397

Group III

Top level traffic engineering position $9,000-$18,000

Board Members See Need for Research And Planning

Board members who recently gathered in Denver for the first meeting in the Rocky Mountain area of the Institute of Traffic Engineers Board of Direction agreed with ITE president Charles W. Prisk that the increased Federal highway aid program now before Congress will mean an acceleration of traffic control work, based on expanded research programs coupled with a steady educational effort to enlist public support.

When interviewed, Board members saw research and planning as necessary fundamentals of traffic engineering and the unsnarling of the country's motor vehicle movement. Higher level governmental bodies, both State and Federal, should help local groups with this planning, they declared, because small city and county governments are unable to raise the money for adequate traffic planning.

The traffic engineers stressed the need of reliance on expert opinion for planning an accelerated highway development with at least a 20-year "extrapolation" into the future. The engineer should continue to sit down with public support groups and give them his technical advice, they said, "You can't afford to go to these civic and governmental groups only in emergencies. You have to share with them the long haul drive for better roads."

Multiplicity of overlapping and conflicting governments and failure of traffic engineers to inform elected officials who make policy decisions were seen as stumbling blocks in highway progress, no matter how much money may be provided for increased programs.

Representative opinions on these subjects, from New York to Los Angeles and from the State of Washington to Atlanta, Georgia, follow: New York—Edward G. Wetzel, assistant chief of the planning division of the Port of New York Authority—"In forecasting traffic trends, we must consider the effect of land use development. We look particularly to the use of air rights and going underground to provide multi-level facilities in congested areas with a minimum tax loss." Mr. Wetzel said that New York State, New Jersey and the Port of New York and Triborough Bridge and Tunnel Authorities have collaborated in planning a $600-million development

D. O. OPSTAD, *General Sales Manager,* Reflective Products Division, Minnesota Mining & Mfg. Co., St. Paul 6, Minnesota.

An open letter to

HIGHWAY ENGINEERS

Compared to new superhighway construction, existing road modernization is an un-spectacular job. But it's a job that badly needs doing. And for the doing it needs sincere public support, based on knowledge of the facts.

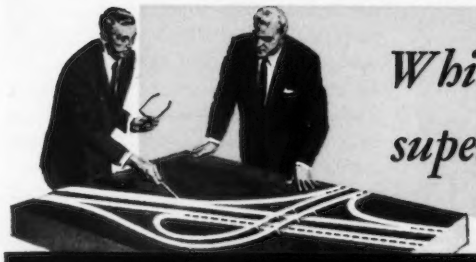
With the message on the page opposite, we hope to help muster that support for your modernization program. This ad appears in the September 7th issue of U.S. News and World Report. It will acquaint leaders in business, government, finance with the urgent need for bringing modern safety measures to roads TODAY.

Like its predecessors in the series, this ad points up increased safety today in the headline, and makes a frank appeal for support for your plans in the body copy.

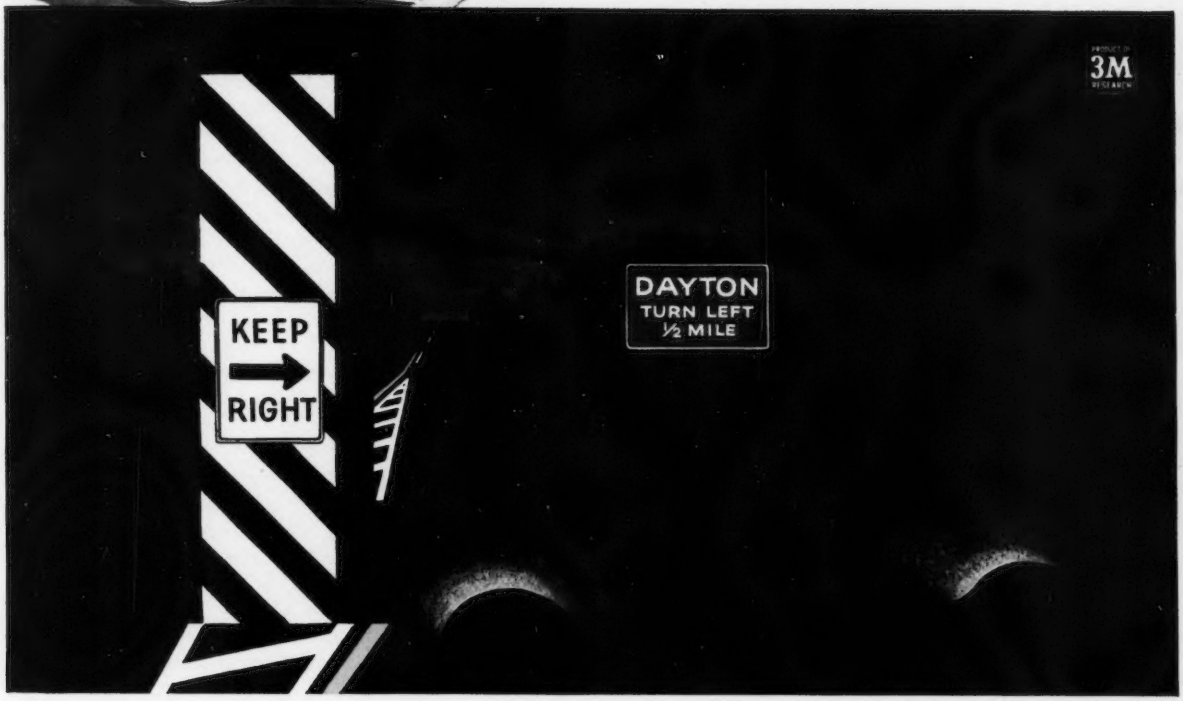
According to reports, these ads are helping to present the facts to interested citizens. One reason is the good use people like yourself are making of them.

D. O. Opstad

P. S. **Can you use reprints of this advertisement in letters or other mailings from your office? Write, stating number of reprints desired to: D. O. Opstad, Reflective Products Division, Minnesota Mining & Mfg. Co., Dept. GS-96, St. Paul 6, Minnesota.**



While they map tomorrow's superhighways . . .



highway engineers are making today's roads safer

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But still more needs to be done!

Funds to speed road modernization are urgently needed by your community and state. *You can help.* Write to your mayor, county commissioner or governor. Let them know you stand behind all efforts to make today's streets and highways safer. The plans you support today may save your life tomorrow.

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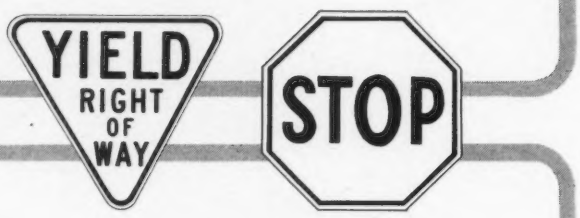

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which is dependent on the anticipated Federal legislation.

Joseph E. Havenner of Los Angeles, technical vice-president of the ITE and director of engineering and technical services of the Automobile Club of Southern California—"Even where large sums of money are available for highway development, we are hampered by an outmoded multiplicity of governments and the failure of traffic engineers to make maximum use of available facilities because of lack of political support." Mr. Havenner said Los Angeles is "a good demonstration of the insatiable demand for improved streets and highway facilities."

J. Carl McMonagle, administrative vice-president of the ITE and planning and traffic director of the Michigan State Highway Department—"It will take all the know-how we have to design the improved facilities now dependent on Congress' action for safety. Michigan alone plans the construction and operation of over 1,000 miles of express highways over a 13-year period at a cost of $1,300,000,000."

Harry Porter, Jr., immediate past president of the ITE and senior traffic engineer for the National Safety Council at Chicago, Illinois—"Small communities need trained traffic engineering staffs they can't afford. I believe that such assistance must be provided by State highway departments or by private engineering consultants. The State can help, as it has in Colorado by making surveys in small towns, where much of the traffic is State traffic and aiding officials in the application of basic techniques, like bringing the timing of signals up to date."

Traffic engineer Allan R. Pepper of the Colorado Department of Highways said that the requirements of record State programs and lack of staff have curtailed the amount of this aid to small communities in the last two or three years.

Karl A. Bevins, traffic engineer of Atlanta, Georgia—"We must obtain an active, educated, constructive interest from groups of leading citizens, like those called for by the President's Highway Safety Conference, to stimulate widespread public support and to get the elected officials to listen to technical advice. We have found that executives realize it is a good business proposition to rely on research."

Alger F. Malo, director of the Department of Streets and Traffic, Detroit, Michigan—"An increased Federal Aid program, it should be remembered, will create added problems for the traffic engineer as it changes traffic patterns. Local and State governments will need to spend money on the construction of new access roads for the new cross-country and cross-state traffic arteries."

Mathew C. Sielski, director of the Safety and Traffic Engineering Department of the Chicago Motor Club—"We have to know not only where we're going but where we're coming from. We face the need to integrate new developments, in housing and industry, to our expressway programs. Chicago will have information available from a $1,800,000 transportation study of the habits of all methods of transportation which took three years to complete and which was a cooperative effort of Federal, State, city and county governments." Mr. Sielski said that an economical, fast, accessible and pleasant means of mass transportation, "something we don't have now," is a prime necessity for the future.

"You're realizing that problem in growing Denver as we do in our larger and still growing Chicago area," Sielski added.

George J. Fisher, director of service of Wichita, Kansas—"Wichita is a city

of recent and greatly accelerated economic development, like Denver, Kansas City and St. Louis. It therefore is relying heavily on the passage of a new highway bill to obtain major thoroughfares both leading to and within it.

"Public acceptance of the new highway program will be a necessity as a part of an overall traffic safety program for these cities and their states, along the lines recommended by the President's Committee."

Herbert C. Higgins, engineer of toll bridges, toll roads and ferries, Washington State Department of Highways—"The Washington State Highway Commission has recently developed and adopted a Master Plan of limited access State highways. All new construction on this will be constructed as fully controlled, barring ribbon development, so that the new roads will remain expressways and will not become crowded streets of merely local use. In our present 3700 miles of primary highways, there will be 1200 miles in this Master Plan.

"We have six toll road proposals being studied, one of which is now in litigation before the State Supreme Court. Our operative facilities are doing as well as Colorado's Denver-Boulder Turnpike.

"But our Commission's Master plan is for the development of needed freeways to accommodate our expanding economy. Its immediate development is, of course, dependent on Congressional action at the present session."

Bell Receives Wiley Award

Hans F. Bell, 8938 S. Emerald Avenue, Chicago, winner of the second C. C. Wiley Traveling Award in Highway Engineering at the University of Illinois shows Professor Wiley the route he followed this summer under the grant. During three months, Bell traveled 4,680 miles through 16 Southern and Eastern states visiting federal, state, county, city, and local highway agencies, toll authorities, universities, contractors, equipment and material firms, transportation agencies, and others associated with highways. He made a series of pictures which with his report will be used later by the University's civil engineering department. The award was established last year by an Illinois contractor and University alumnus in honor of Professor Wiley, who retired in 1952 after 46 years of pioneering activity in highway and traffic research and teaching.

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The driver of an emergency vehicle can have uncontested, clear right-of-way for blocks ahead . . . he can stop all traffic on his route. He does it with EL-TEC, an electronics system for controlling traffic from a moving emergency vehicle.

EL-TEC is new, but years of research and development have proved its dependability. The system and equipment have been hailed as the most important stride in emergency traffic safety in many years.

EL-TEC has been commended by the nation's leading police, fire and traffic officials as well as various State Safety Committees and Highway Commissions.

Electronic Protection Inc.

Subsidiary of Standard Coil Products Co. Inc.
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The Only FCC Approved System For Emergency Traffic Control

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GET THE FACTS!
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You owe it to yourself, your community, your firemen, policemen and all emergency drivers to learn how low-cost, reliable EL-TEC Radio Traffic Controllers can save lives, prevent suffering, cut down property damage, keep all emergency equipment "in service."

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2083 North Hawthorne Avenue, Melrose Park, Illinois.
☐ Please have representative call.
☐ Please send literature on EL-TEC.
Name_____
Title_____
Address_____
City_____ State_____

New Appointments

Schmidt Joins Automatic Signal

Robert E. Schmidt (Mem., ITE) joined the sales engineering staff of Automatic Signal Division, Eastern Industries, on June 15.

Bob expects to operate from the company headquarters in East Norwalk,

Robert E. Schmidt

Conn., and studying Automatic's new traffic-actuated master control equipment and the traffic monitor system designed for remote surveillance of parkway traffic. In going with Automatic, he joins other I.T.E.'ers Paul Green, John Barker, Ed Mogren, and Ed Eames.

Bob has covered considerable territory since graduating from the Yale Bureau of Highway Traffic in 1947. After two years with the Washington State Highway Department as District Traffic Engineer in Vancouver, he spent four years in Tacoma as that city's first traffic engineer. Returning East in 1953, he went with the Yale Bureau as research assistant and instructor, and spent two and a half years as Resident Traffic Engineer at the Eno Foundation. With M. Earl Campbell of the Highway Research Board, he co-authored a book on "Traffic Generation and Distribution," soon to be published by the Eno Foundation.

The Schmidts are staying in Westport, having just purchased a home at Compo Beach. Bob's first do-it-yourself project will be a raft for emergency use by wife Helen, son Geoffery, dog Mindy, and himself during the fall hurricanes.

Williford with Port Authority

Robert E. Williford (Jr. Mem., ITE) accepted a position with the New York Port Authority in February of this year as Traffic Engineer II, and will work under the supervision of Louis E. Bender (Mem., ITE) who is the Chief of the Traffic Engineering Division. Bob

Robert E. Williford

will participate in traffic surveys at tunnels, bridges and airports; geometrical design of bus terminals; intersections, toll plazas and parking lots; and traffic signalization projects.

A native of Scherron Lake, New York, he served with the United States Navy Seebees. He graduated from Manhattan College with a Bachelor of Science degree in civil engineering in June, 1947, and received the professional civil engineering degree in traffic from North Carolina State in June, 1951.

He has been connected with Keis and Holroyd, Consultants in New York and with the Mayersohn Construction Company in Albany, New York. While serving as City Traffic Engineer in Rocky Mount, North Carolina from 1951 to 1954, he participated in several traffic engineering projects with W. F. Babcock (Assoc. Mem., ITE). His last position was with the city of Philadelphia from 1954 to 1956 as Traffic Safety Engineer.

He is a member of the American Society of Civil Engineers and the National Safety Council.

Bob married the former Betty Van Derwalker of Scherron Lake, N. Y. and they have a son, eight years and two daughters, five and two.

Bilby Accepts State Position

Wm. H. Bilby (Assoc. Mem., ITE) resigned his position as City Traffic Engineer, Indianapolis, Indiana, May 1st and accepted the position of Engineer of Traffic for the State Highway Department of Indiana. In his new job Mr. Bilby will be in charge of the State

William H. Bilby

Traffic Engineering Department under Charles D. Miller, Engineer of Traffic and Planning. He will be located in Indianapolis. It was a case of going back home for him as he had worked in the State office several years ago.

Mr. Bilby graduated from Purdue University in 1932. He worked in the Planning Department for the Indiana State Highway Department for some time. During the war he was an instructor in Physics for Air Force Cadets at Butler University and in 1944 became an assistant traffic engineer for the Indiana State Highway Department. A year later he was placed in charge of the Traffic Signal Department where he stayed until 1948. At that time he accepted a position as Consulting Traffic Engineer with a firm in Indianapolis.

In 1951 he was appointed assistant traffic engineer for the City of Indianapolis and became head of the Traffic Department the next year. He was the first professional traffic engineer to hold this position in the City and the results he achieved were very outstanding. In 1951 the City of Indianapolis was rated at the bottom of the list in its population class as rated by the National Safety Council for fatalities. In 1955 the City

(Continued on page 574)

PARK-O-METER No. 500,000 in service in CEDAR RAPIDS, IOWA

Commissioner Prochaska and Superintendent Ahring write the entire Cedar Rapids story

I wish to congratulate Magee-Hale Park-O-Meter Company for having produced a half million Park-O-Meters. We are indeed pleased to have the half-millionth Park-O-Meter in Cedar Rapids.

Before buying your meters, I wrote to some 42 cities, and their information was very helpful to me in deciding to replace the manual type meter with Park-O-Meter. You can rest assured that it was no easy matter for me to buy Park-O-Meters because of the tremendous pressure from other meter company salesmen.

We have a total of 1732 meters on the streets and in off-street lots. We have presently 6 off-street parking lots, all of which are metered. Some all-day meters, others range from 4-hour meters to 12 24-minute meters.

In attending Safety Conferences and Municipal meetings in other cities parking meters are usually discussed and I am very proud to say that those cities which have Park-O-Meters are very much satisfied.

E. A. Prochaska

E. A. PROCHASKA
COMMISSIONER
DEPARTMENT OF PUBLIC SAFETY

We started operating meters in 1946, at which time 800 were installed. These were a manual type meter and, with two service men, it finally became impossible to handle the service calls . . . as high as sixty a day.

In 1952 we started replacing 1000 other meters with Park-O-Meters. The replacement was completed in a year, and at this time we have in operation 1732, all of which are Park-O-Meters. Our service department still operates with two men, who handle it very easily.

F. Ahring

F. A. AHRING
SUPT. OF METERS

Magee-Hale
PARK-O-METER COMPANY
Commerce Exchange Bldg.
OKLAHOMA CITY 2, OKLAHOMA

Automatic Signal Promotes Mogren

Paul L. Green (Mem., ITE), Sales Manager for the Automatic Signal Division of Eastern Industries, Inc., has appointed Edward G. Mogren (Assoc. Mem., ITE) as Assistant Sales Manager.

Automatic Signal is the originator

Edward G. Mogren

and foremost manufacturer of traffic actuated signal control equipment. They also make the Radar Speed Meter and "PR" Controllers for coordinated signal systems.

Ed has been a member of the Automatic Signal sales engineering staff since November, 1952. He will continue to work out of Automatic's Norwalk, Connecticut office.

BILBY

(Continued from page 572)

was in second place and was nosed out of first by only one fatality.

The following editorial appeared in the Indianapolis News when Mr. Bilby resigned. It reflected the unusual relationship he had developed. "Our City has lost the services of Wm. H. Bilby, probably the most capable traffic engineer it ever had.

"He is the man who developed and expanded the one-way street system. He has been responsible, more than any other individual, for lessening traffic congestion, for enabling motorists to get to and from the downtown district with a minimum of inconvenience and delay. He has provided the city with an efficient traffic control plan."

Mr. Bilby and his wife recently moved into a new home in a suburban area northwest of Indianapolis. He is Vice-President of the Indiana Section of ITE and has been active in the Section since it was started.

Bossi Becomes City Traffic Engineer

Alfred A. Bossi (Jr. Mem., ITE) has recently accepted a position of Traffic Engineer in the city of Las Vegas, Nevada. His previous assignment since 1953 was with the Alameda Traffic Department in Oakland, California.

Alfred A. Bossi

Al graduated from West Virginia University with a Bachelor of Science degree in civil engineering in June, 1953. His major professor, William Downs, attracted his interest toward the traffic engineering field.

He is a native of West Virginia and served with the United States Navy in World War II.

New Driver Improvement Manual Available

The American Association of Motor Vehicle Administrators has marked a milestone in its progress with publication of a revised and greatly enlarged edition of "Driver Improvement Through Licensing Procedures."

The 208-page volume, subtitled "A Manual for Driver-Licensing Authorities in the Control of Problem Drivers," contains a total of 16 chapters, 11 of them completely new and two others substantially revised. As originally published in 1950 the manual had five chapters and a glossary of terms.

For the first time the Association has a complete, authoritative guide for administrators in this major area of their interests. This manual extends to the administrative level the fundamental concepts on driver licensing of the Uniform Vehicle Code and of the State laws patterned on it. It establishes a standard with which any jurisdiction may compare its own driver-improvement activities. It summarizes the best solutions found by States and Provinces to problems arising in trying to protect the public from drivers who have failed to perform as well as expected when originally licensed.

Developed over an eight-year period, the manual has been a project of AAMVA's Driver License Committee under three chairmen: A. F. Temple, Director of Driver Licensing, Texas Department of Public Safety; A. H. Henderson, Director, California Department of Motor Vehicles, and John Kerrick, Manager, Driver License Division, Oregon Department of State.

Copies of the new publication are available from AAMVA, at $3 per single copy, or $2 per copy in quantity orders of 10 or more copies.

Highway Job Given Fowler

Traffic Engineer Fred T. Fowler (Mem., ITE) will give up his job August 1 to become city co-ordinator of highway engineering in Portland.

The city council has assigned Fowler the job of working out Portland's share

Fred T. Fowler

in the multibillion dollar federal highway aid program.

City Commissioner William A. Bowes said Fowler will remain in city employ but will serve as liaison man with the Oregon state highway commission and neighboring road agencies.

He will report regularly to the city council on progress of the highway program but will be assigned directly to the staff of Bowes, commissioner of public works.

Bowes said William J. Weller, present assistant to Fowler, will become traffic engineer on a temporary basis. The job will be filled permanently by civil service examination.

Barry Moves to Florida

Donald W. Barry (Assoc. Mem., ITE) formerly traffic engineer for the city of Fort Wayne has accepted the position of Engineer of Traffic and Planning for the city of Orlando, Florida. This department is a new one in the city and he

Donald W. Barry

will be directly responsible to the Mayor and Traffic Commission.

Don received his education in Fort Wayne, Indiana and served in the Navy Air Corps from 1943 to 1945. After separation from the Navy, he received a Bachelor of Science degree in civil engineering from the Indiana Technical College in Fort Wayne.

Upon completion of his college education, he was employed by the Indiana State Highway Department in the Fort Wayne district. While employed with the Indiana State Highway Department he assisted in all phases in rural traffic control, signalization and signs and markings.

From 1951 until 1953 he served as an instructor in the civil engineering department of the Indiana Technical College. He taught courses in the civil engineering department dealing with highway and traffic engineering.

Don became traffic engineer for the city of Fort Wayne in July, 1953 and served in this capacity until his recent acceptance of a position in Orlando. While in Fort Wayne, he was responsible for instituting a new model traffic ordinance, installing a new signal system, and other traffic engineering improvements.

In addition to being an Associate Member of the Institute of Traffic Engineers, he is a member of the National Society of Professional Engineers and is a registered professional engineer in the state of Indiana. He also served as secretary-treasurer of the Indiana Section of the Institute of Traffic Engineers.

Kunde Named Director

George H. Kunde (Jr. Mem., ITE) has been named director of the Miami, Fla., Offstreet Parking Board, heading the new city department established last December.

Appointed the first director by the

George H. Kunde

city manager upon recommendation of the Board, Kunde will also continue as city traffic engineer, the position he has held since September, 1955.

The Offstreet Parking Department was created to seek relief for acute parking problems of the fast-growing area. Miami is one of the first cities to combine the positions of traffic engineer and parking director.

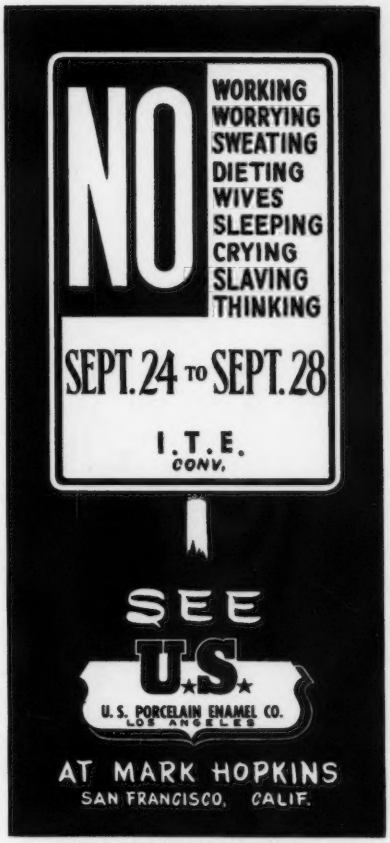
William L. Pallot, Miami attorney who is chairman of the Offstreet Parking Board, in making the announcement said, "We are elated by Kunde's appointment. We feel he is eminently qualified with his rich background in engineering traffic and transportation, all of which go hand in hand with providing the needed offstreet parking in the metropolitan Miami area."

Kunde, 31, is a native of Miami and graduate of Miami Beach High School and the University of Miami. He is a veteran of the Army Air Force, having served four years as a pilot.

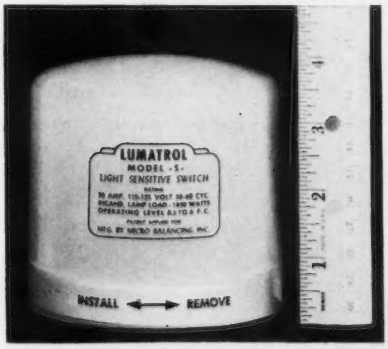
New Lumatrol Needs No Orientation

A new light sensitive switch for street lighting control has been developed by Micro Balancing, Inc.

Although interchangeable with Lumatrol Model "A", and incorporating the same convenient plug-in-out design adaptable to any make luminaire, the new Model "S" offers several startling advances in light control for street and highway installation. A novel departure from conventional circuitry for this type device is the elimination of the photo-

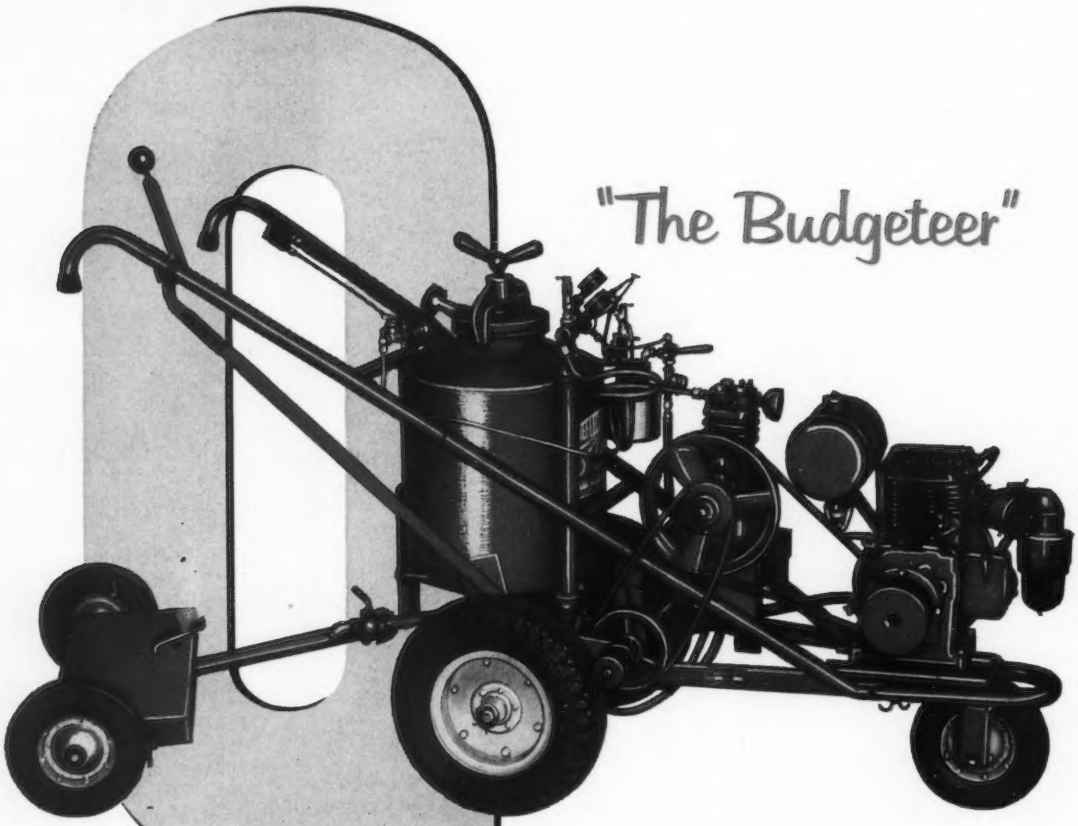


tube. Instead the unit utilizes a light sensitive cadmium sulfide cell, said to have infinite life and minimum sensitivity to atmospheric changes. The C/S cell provides the means which results in an exceptionally stable, low impedance circuit, not possible to attain when the photo-tube is used. Of special interest to those concerned with fully automatic



street lighting control is the completely omni-directional light sensing characteristic of the Model "S". Accurately sensing the mean light level, regardless of obstructions, shadows or compass direction, the unit needs absolutely no orientation. The Model "S" is said to be the smallest, most compact fully automatic light control.

WALD REFLECTO-LINER MODEL



OUTSTANDING PERFORMANCE ! ASTOUNDING BUY !

All the *outstanding performance* of a big machine . . . well-balanced, sturdy monoframe chassis . . . smooth self-propelled traction with exclusive elbow-action drive* and fingertip control . . . 12 gallon capacity . . . 100% air reserve, 9.3 cfm . . . Wald Nu-Matic spray gun and Wald Shroud . . . handles paint and viscous reflective material . . . standard parts . . . powerful engine . . . many accessories, including outboard striping arm.

For town and industry, "The Budgeteer" is truly *an astounding buy* because it is the *big striper* with the *small price tag*—and very low maintenance cost! Moreover, it is convertible to many other uses that add greatly to it's value.

*Pat. applied for

WALD INDUSTRIES, INC.
HUNTINGDON, PENNSYLVANIA

Coming Events

Sept. 17-19—AMERICAN ROAD BLDRS. ASSN. National Highway Conference of County Engineers and Officials, Grand Hotel, Mackinac Island, Michigan. Contact: ARBA, World Center Bldg., Washington 6, D. C.

Sept. 17-20—AMERICAN TRANSIT ASSN. — Annual Meeting, Jefferson Hotel, St. Louis, Mo. Contact: ATA, 292 Madison Ave., New York 17, N. Y.

Sept. 17-20—INTL. MUNICIPAL SIGNAL ASSN. —Sixty-first Annual Meeting, Cosmopolitan Hotel, Denver, Colo. Contact: IMSA, 130 W. 42nd St., New York 36, N. Y.

Sept. 17-20—ILLUMINATING ENG. SOCIETY— National Technical Conference, Statler Hotel, Boston, Mass. Contact: IES, 1860 Broadway, New York 23, N. Y.

Sept. 23-26—AMERICAN PUB. WORKS ASSN.— Annual Congress, Fort Worth, Texas. Contact: APWA, 1313 E. 60th St., Chicago 37, Ill.

Sept. 25-27 — INSTITUTE OF TRAFFIC ENGINEERS —Annual Meeting, Mark Hopkins Hotel, San Francisco, Calif. Contact: ITE, 2029 K St. N.W., Washington 6, D. C.

Sept. 30 - Oct. 2 — AMERICAN CONGRESS ON SURVEYING & MAPPING and AMERICAN SOCIETY OF PHOTOGRAMMETRY — Fall Convention and Co-Exhibit, Shirley-Savoy Hotel, Denver, Colo.

Oct. 15-19—AMERICAN SOC. OF CIVIL ENG. —National Convention, Wm. Penn Hotel, Pittsburgh, Pa. Contact: ASCE, 33 W. 39th St., New York 18, N. Y.

Oct. 22-24 — AMERICAN STANDARDS ASSN. —Annual Meeting, Hotel Roosevelt, New York City. Contact: ASA, 70 E. 45th St., New York 17, N. Y.

Oct 22-26—NATIONAL SAFETY COUNCIL — 44th National Safety Congress and Exposition, Congress, Conrad Hilton and other hotels, Chicago, Ill. Contact: NSC, 425 N. Michigan Ave., Chicago 11, Ill.

Nov. 27-30 — AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS — 42nd Annual Meeting, Traymore Hotel, Atlantic City, N. J. Contact: AASHO, 917 National Press Bldg., Washington 4, D. C.

— 1957 —

Jan. 7-11 — HIGHWAY RESEARCH BOARD — Annual Meeting, Sheraton-Park Hotel, Washington, D. C. Contact: HRB, 2101 Constitution Ave., Washington 25, D. C.

Jan. 28-Feb. 2—AMERICAN ROAD BLDRS. ASSN. Annual Convention and Road Show, Chicago Amphitheatre, Chicago, Ill. Contact: ARBA, World Center Bldg., Washington 6, D. C.

Feb. 18-22—AMERICAN SOC. OF CIVIL ENG.— Convention, Hotel Heidelberg, Jackson, Miss. Contact: ASCE, 33 W. 39th St., New York 18, N. Y.

March 17-21—AMERICAN SOCIETY OF PLANNING OFFICIALS —Annual Planning Conference, Sheraton-Palace Hotel, San Francisco, Calif. Contact: ASPO, 1313 E. 60th St., Chicago 37, Ill.

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TRAFFIC and STREET SIGN COMPANY

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Membership Applications

The following applications have been received since the list of applicants in the August issue.

APPLICATIONS FOR TRANSFER

BAERWALD, John E.
Asst. Professor of Traffic Engineering
University of Illinois
401 Civil Engineering Hall
Urbana, Illinois
July 26, 1956 for MEMBER grade

BERGSTROM, Donald E.
Engineer II, Leadman
526 S. W. Mill Street
Portland, Oregon
July 19, 1956 for ASSOCIATE grade

DeNOBLE, Henry M.
Director of Planning & Traffic
City Hall
Springfield, Missouri
August 1, 1956 for ASSOCIATE grade

O'CONNELL, Robert C.
Traffic & Planning Engineer
Wyoming Highway Department
Cheyenne, Wyoming
July 20, 1956 for MEMBER grade

OLCOTT, Edward Sumner
Project Coordinator for Arterial Facilities
The Port of New York Authority
111 Eighth Avenue
New York 11, New York
July 18, 1956 for ASSOCIATE grade

MARVIN, William L.
Highway Traffic Engineer III
Metropolitan District Traffic Engineer
Michigan State Highway Department
17405 Lahser Road
Detroit 19, Michigan
July 30, 1956 for MEMBER grade

WILLIFORD, Robert E.
Traffic Engineer II
The Port of New York Authority
111 Eighth Avenue
New York 11, New York
July 18, 1956 for MEMBER grade

(Continued on page 582)

Institute Affairs

The big news in the ITE world is, of course, the Annual Meeting in San Francisco. The program is printed in this issue in what the Program Committee hopes will be final form—but last minute changes can and frequently do occur. Final programs will, of course, be available at the registration desk.

The Board of Direction will meet on Monday, September 24th. This will be the last meeting for the present Board. The Membership Committee has been invited to sit with the Board during the discussion of membership applications and other membership matters.

Speaking of membership, it is quite likely that the Institute's 1000th member will be elected at this meeting. The membership total following the May meeting was exactly 999—and various factors of resignations, delinquents dropped, and other changes will bring the total down to about 992 or 993 by September 24th. An announcement will be made as soon as possible after the event if and when it occurs.

Another item of interest to the Institute is the change in procedure for resolutions at the Annual Meeting. The Resolutions Committee has been appointed by President Prisk and asked to submit their proposed resolutions to the Board at the Monday meeting. This method was voted by the Board in May, and, it is hoped, will produce more carefully thought out and worthwhile resolutions.

Members of the Resolutions Committee are:

A. F. Malo, *Chairman*

J. F. Exnicios	A. H. Vey
C. E. Fritts	M. H. West
J. A. Head	T. T. Wiley

The Annual Business Meeting, for members of all grades, will take place Thursday morning, September 27th. Of principal interest will be the report of the tellers and the introduction of the new officers.

A Correction

In the list of new members and transfers published in the July issue, an error occurred which should be noted and corrected. John E. Hartley, who was transferred from Junior to Associate, is City Traffic Engineer of Springfield, Illinois.

Not shown in the list was Harold L. Hickman, who was also transferred from Junior to Associate, and who is City Traffic Engineer in Flint, Michigan.

Our apologies to both of these new Associate Members.

New Sustaining Organizations

Two new Sustaining Organizations are included in the present list, following acceptance of invitations by the Aluminum Corporation of America and Flex-O-Lite Manufacturing Company. These become our 27th and 28th Sustaining Organizations.

Alcoa has named M. R. Schuster, whose title is Supervisor, Sign Industry, as their representative. He has also been named to Committee 7C, Development of Sign Illumination Techniques. R. C. Kasser has been named to serve with Committee 7A, Traffic Signals, and R. M. Peters to Committee 7E, Design of Signs and Markings.

Flex-O-Lite has designated its president, Mr. Preston D. Law, as representative, and has offered his services to Committees 7D, Paint and Bead Specifications, and 7F, Design of Signs and Markings. James R. Beard has been named to serve with Committee 7B, Colored Reflective Signs.

Activities of Members in ITE Affairs

Dave Solomon (Junior Member) passed along a tabulation he made of Institute members' participation in ITE affairs. His criterion was the Yearbook listing of a member on a committee or in some other formal activity of the Institute. While he holds no brief for the complete accuracy of his tabulations, it is probably about right. The evidence is very clear that the Juniors do not take as much part in ITE affairs as Associates or Members—a fact which will surprise no one. The figures do emphasize, however, the need for more efforts to bring the younger men into committee work.

Solomon's figures are as follows:

		Per Cent Participating in:				
Members (in 1956 Yearbook)		1 Activity	2 Activities	3 Activities	4 or more Activities	1 or more Activities
Grade	No.					
Juniors	231	9	5	1	0	15
Associates	399	23	7	2	*	33
Members	284	27	16	9	5	57
Total	914	21	9	4	2	36

*Less than 0.5%

Publications Received

Many reports and publications come into the Headquarters office, and all of them are of some interest. A few, however, are of general enough interest to deserve some mention here. The following are in this category:

Highway Research Board Bulletin 120: *Traffic Accidents and Violations.* This publication reprints five papers presented at last January's meeting of the Board.

Annual Report, 1955, Department of Traffic Engineering, City of Baltimore, Maryland. A very complete and descriptive report on a year's activities.

Section News

MID-ATLANTIC SECTION

At the May meeting of the Board of Direction of the Institute of Traffic Engineers the formation of the Mid-Atlantic Section was approved. The Mid-Atlantic Section is the thirteenth section of the Institute. The minutes of their first section meeting, which was held on June 20, in Harrisburg, Pennsylvania, follow:

The Mid-Atlantic Section of the Institute of Traffic Engineers got underway at a meeting in Harrisburg, Pennsylvania, on June 20, attended by twenty-four Members, Associates and others interested in the activities of the Section.

Jack Comiskey called the meeting to order and read the authorization of the Board of Direction of the Institute, which was issued on the basis of petitions signed by twenty-six Members and Associates. *Bob Holmes* outlined the plan of organization of the Section and its purposes and objectives.

Mike Gittens was elected President; *Paul Muffley,* Vice President; and *Bill Canning,* Secretary and Treasurer.

The Section offered its co-sponsorship to Pennsylvania State University in furtherance of the Traffic Problems Conference which is to be held October 30 and 31.

Constitution and By-Laws were adopted and meeting dates set, the Annual Meeting being scheduled for sometime about the first of November, subject to the call of the Executive Committee.

WILLIAM S. CANNING
Secretary-Treasurer

ROBBINS Vinyline street markers

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TRAFFIC CONES

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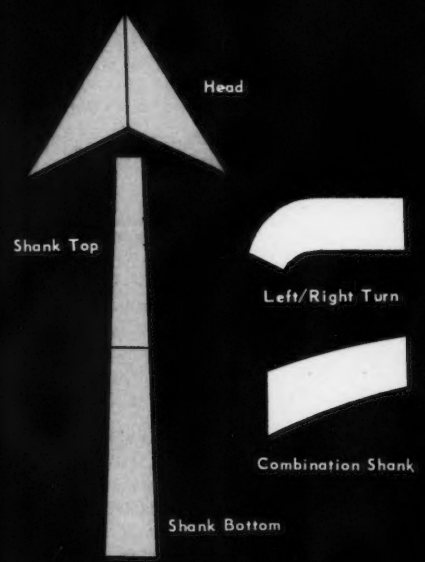

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come in easily assembled sections

. . . and here's a superior new

TRAFFIC CONE

Robbins new Traffic Cones are the answer to the great demand for a superior cone to withstand the wear and tear of heavy use. Made of all new long life rubber, they will not tear or break under hard wear. Brilliant colors are molded into the rubber and will not wear off – they never need painting. You can depend on them . . . they are guaranteed for five years of normal wear!

You will want complete information about Robbins traffic line control products. Write, wire or telephone for samples today.

ROBBINS TIRE & RUBBER CO., INC.
TUSCUMBIA, ALABAMA

SIDNEY J. WILLIAMS

Sidney J. Williams (Honorary Member) died August 5 in Evanston, Illinois, after a short illness. He was 70 years old.

Frequently referred to as the "dean of traffic safety," Mr. Williams retired several years ago after more than 30 years on the staff of the National Safety Council. He had maintained contact with the field, however, by service as an advisor to the Council and as chairman of the National Committee on Uniform Traffic laws and Ordinances, in which he was very active up to the time of his last illness.

Although not listed as one of the Founders of the Institute, he was active in the affairs of the embryo organization immediately after the initial meeting. He served as director for four years, from 1933 to 1937, and was elected an Honorary Member in 1951.

He was the author of two books and many technical articles. His interests were varied, and he was active in many industrial safety areas as well as in the field of traffic. He served as a safety consultant to the Atomic Energy Commission, was one of the key figures in the American Standards Association. and a consultant to both traffic and industrial safety conferences called by the White House.

Mr. Williams was a member of ASCE, SAE, Phi Beta Kappa, Tau Beta Pi, and Alpha Delta Phi. In 1938, he won the C.I.T. Safety Foundation award and in 1950 was named the Beecroft Memorial Award lecturer by the Society of Automotive Engineers. In 1954 he won the Arthur Williams Memorial Award.

Active in community affairs, he was chairman of the board of trustees of the First Congregational Church in Evanston.

He is survived by his wife, Margaret, and two daughters.

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All-Rubber TRAFFIC GUIDES
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NOW IN 3 SIZES!
28 IN.
18 IN.
12 IN.
SPECIAL ADAPTERS INCREASE USES!
Signs-Flashers-Flag Adapters
PAINTED OR REFLECTORIZED
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City Traffic Engineer

Requirements: Eight years supervisory experience in traffic engineering or degree in civil or traffic engineering and four years supervisory experience. Examination by rating of training and experience.

Salary: $750-$800 per month

Apply: Municipal Civil Service Board
Room D
234 S. W. Clay Street
Portland, Oregon

Closing Date: September 24, 1956

City Planner II

Qualifications: College graduate with minimum of two years experience in city planning, traffic engineering or civil engineering. Master's degree in civil engineering can be substituted for one year of experience.

Salary: $5,580 per year with future increases up to $6,000.

Apply: Lloyd T. Keefe, City Planning Commission, 414 City Hall, Portland, Oregon.

HAMILTON, OHIO
City Traffic Engineer. Staff level position in established department.

Qualifications: Engineering graduate with special courses in traffic engineering with experience preferred. Age 25-50.

Salary: $5,508 to $6,708 per year. Starting salary contingent on education and experience.

Apply: Personnel Director, 254 Municipal Building, Hamilton, Ohio.

RIVERSIDE, CALIFORNIA
City Traffic Engineer

Qualifications: Civil Engineering graduate with two years of experience in traffic engineering or an equivalent combination of training and experience.

Salary: $478 to $598 per month

Apply: Personnel Department, City Hall, Riverside, California.

ROCKFORD, ILLINOIS
City Traffic Engineer

Requirements: College degree, with specialization in traffic engineering, followed by 5 years of progressively responsible experience in the traffic engineering field.

Salary: $587.10 to $728.10 per month.

Contact: Application blanks and further information from Rockford Civil Service Commission, 126 South First St., Rockford, Illinois.

FORT LAUDERDALE, FLORIDA
City Traffic Engineer

Qualifications: Engineering graduate, with one year of graduate study or equivalent. U. S. citizen, age 21-45.

Salary: $5,525 to $6,903 per year.

Apply: Robert A. Earle, Personnel Director, City Hall, Ft. Lauderdale, Florida.

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Section News

WESTERN SECTION

The Board of the Institute of Traffic Engineers, headed by President Charles Prisk, met in Denver, Colorado on May 25 and 26, 1956. Denver traffic engineer Jack Bruce and Colorado Department of Highways' traffic engineer Allan Pepper headed the host committee. The Western-ITE had the following to report on the affair:

About 40 members, friends and guests attended the business and social functions, in addition to the Officers and Board members. *Ray Halverson* came over from Utah and *Bob O'Connell* came down from Wyoming. *Francis Burton* came up from New Mexico, complete with his beard commemorating Albuquerque's 250th Anniversary.

The members started to convene in Denver on Thursday noon, May 24 and by the time evening had arrived, there were enough of the Officers and Directors assembled that those traveling ambassadors, *DeYoung* and *Henberger*, thought it would be proper to give the members a little fresh air and they were hustled off to a rustic mountain lodge called "El Rancho Grande" and there they were introduced to Rocky Mountain prime ribs of beef. *V. P. McMonagle* had trouble resisting the urge to take over the music department and it was then that some of us learned, for the first time, that he actually has his own dance band as part of his division in the Michigan State Highway Department.

Promptly on Friday morning, the members assembled for their business meeting and *Bob Livingston*, from the Colorado Department of Highways, handled the welcoming chores and read letters from *Governor Johnson, Mayor Nicholson* of the City and County of Denver and one from the President of the Colorado Society of Engineers.

At noon the Board adjourned for a brief luncheon period, with the honored guest being the President of the Rocky Mountain Motor Club, *Clarence Werthan.* Needless to say, there was a lot of good natured jostling between *Messrs. Werthan, Havenner* and *Sielski* regarding their respective automobile associations.

In the evening a social was held preceding the banquet with some of the larger sustaining organizations combining to help out the Rocky Mountain area. The Officers and members were guests of the area group at the banquet and as such they were forced to submit to humorous introductions given by the M.C. in the person of *Al Pepper.*

On Saturday morning, the Board sessions resumed and all of the business had been completed by 1:00 P.M. at which time all of the members and guests adjourned to Lookout Mountain, west of Denver and enjoyed a buffet luncheon in a mountain retreat known as "Hatton's Hacienda." Incidentally, *Bill Hatton* is the local representative of the A'G'A' Division, together with *Jack Henberger*, they were the perfect hosts. *Mesdames Henberger, Hatton* and *DeYoung* lead the impromptu hostess committee. Following the mountain "soiree" several members had to be rushed back to the airport, including *Joe Havenner*; whereas, the others took side trips over the Denver-Boulder Turnpike, etc. That evening an informal broiled steak dinner was held for a goodly number of the Board members in the home of *Al Pontius*, a local representative of the 3-M Company and he was assisted by *Phil McCauley*, out of *Don Opstad's* office.

Most of the remaining members then departed on Sunday A.M. and, to the best of *Al Pepper's* knowledge, all of them made their plane schedules on time, even including the Board member from New York City.

The Western Section, through the Rocky Mountain area membership, was extremely happy to have been selected for the Board Meeting site and it is hoped that the Officers and Directors will want to come back to the West again for one of their regular Board meetings (even over and above the one which will be held in San Francisco). *Al Pepper* reports that they were extremely fortunate in getting good press coverage on the event and were able to place mass interviews on the wire services. This, definitely, promoted the cause of traffic engineering in the West and he reports that he felt it also contributed to the prestige of the Institute.

Al Pepper, as head of the arrangements committee, would publicly like to thank the other committee members in the persons of *Jack Bruce, Jerry Rothweiler* and *Jim Small.*

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MEMBERSHIP APPLICATIONS

(Continued from page 577)

NEW APPLICATIONS

BERMAN, Jack
Assistant to the Staff Director
National Committee on Urban Transp.
1346 Connecticut Avenue, N. W.
Washington 6, D. C.
July 30, 1956 for JUNIOR grade

CABRERA, Julio E. Vazquez
Chief, Accident Analysis Section
Assistant Chief of Division
Traffic Bureau
Dept. of Public Works
Santurce, Puerto Rico
August 3, 1956 for JUNIOR grade

ESTRIDGE, Jack Murrey
Assistant Traffic Engineer
Quinton Engineers Ltd.
812 West 8th Street
Los Angeles, California
July 28, 1956 for JUNIOR grade

GEORGE, Earl Theodore, Jr.
Assistant Traffic Engineer
Division of Traffic Engineering
Room 306, City Hall
New Orleans, Louisiana
July 23, 1956 for JUNIOR grade

HILLER, Sherwood H.
Assistant Engineer of Traffic
State Road Department of Florida
Holland Building
Tallahassee, Florida
July 3, 1956 for ASSOCIATE grade

KING, Howard Woodson
Instructor, Civil Engineering
Michigan College of Mining & Technology
Civil Department, MCMT
Houghton, Michigan
July 16, 1956 for JUNIOR grade

KLOAC, George Edward
Traffic Engineer II
Bureau of Street Traffic & Parking
321 North LaSalle Street
Chicago, Illinois
August 1, 1956 for JUNIOR grade

LASH, Michael
Highway Engineer
U. S. Bureau of Public Roads
500 Capitol Avenue
Hartford, Connecticut
July 18, 1956 for JUNIOR grade

OSGOOD, Robert William
Traffic Engineer
Oakland County Road Commission
550 S. Telegraph Road
Pontiac, Michigan
August 2, 1956 for ASSOCIATE grade

RICHEY, Maurice
Traffic Engineer
Montana State Highway Department
Helena, Montana
June 29, 1956 for JUNIOR grade

RIMBERG, Felix Justus
Architect - Planner
Master Planning Division
WPAFB, United States Air Force
EWFP, Wright-Patterson AFB
Dayton, Ohio
July 23, 1956 for JUNIOR grade

SCHWARZ, Robert Henry
Captain, U. S. Army Transportation Corps
OSATE, OCOFT, Department of Army
Washington 25, D. C.
July 25, 1956 for JUNIOR grade

STREB, Paul Lawrence
Assistant Traffic Engineer
Department of Public Works
Traffic Engineering & Highway Planning
245-A State Office Building
Providence 2, Rhode Island
July 3, 1956 for JUNIOR grade

THORNTON, Joseph L.
District State Aid Engineer
Department of Highways
State of Washington
6431 Corson Avenue
Seattle 8, Washington
July 3, 1956 for ASSOCIATE grade

WATSON, Frank Llewellyn
Traffic Signal Engineer
Traffic & Transportation Dept.
702 City Hall
Houston, Texas
July 27, 1956 for JUNIOR grade

WILLIAMS, Robert Carroll, Jr.
City Planning Engineer
City Hall Annex
Spartanburg, South Carolina
July 28, 1956 for JUNIOR grade

CORRECTION

In the July issue, reference was made to the offer of a free bead dispenser by Flex-O-Lite Manufacturing Co. The item should have said that the offer is limited to those ordering a minimum of 2,000 pounds of "Free Flow" beads.

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